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## RELATION OF BRONCHIECTASIS TO INFECTION OF THE PARANASAL SINUSES

G E HODGE, MD

MONTREAL, CANADA

During the past fifteen years widespread interest in the relationship of bronchiectasis to infection of the paranasal sinuses has been shown by the numerous articles which have appeared in the medical literature, especially in journals devoted to otolaryngology. This interest has been increased by the stimulating advances made in the fields of bronchoscopy, roentgenology and thoracic surgery and particularly by the increased knowledge of the reaction of the mucous membranes of the respiratory tract to allergy and to infection. The knowledge, however, of some of the phases of this relationship is still obscure. A brief résumé of the literature will help to summarize the present views on the subject.

### CAUSAL RELATIONSHIP

As early as 1914 Thomson<sup>1</sup> suggested that persistent bronchorrhea might be due to chronic suppuration of the sinuses. Later Sergent,<sup>2</sup> Rist,<sup>3</sup> Webb and Gilbert<sup>4</sup> and others, noting the presence of sinusitis in patients with pulmonary suppuration, stressed the importance of a thorough examination of all the sinuses of these patients. Mullin<sup>5</sup> noted that in almost all his patients with bronchiectasis coexisting sinusitis occurred. He believed that primary bronchitis has a tendency to clear up unless it is kept active by a well marked infection of the sinuses.

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Read before the Section on Laryngology, Otology and Rhinology at the Eighty-Sixth Annual Session of the American Medical Association, Atlantic City, N J, June 13, 1935.

1 Thomson, St Clair. Some of the Symptoms and Complications of Sinusitis, *Practitioner* **92** 745 (June) 1914.

2 Sergent, Emile. Histoire suggestive de quelques faux tuberculeux, diagnostics différentiels de la tuberculose pulmonaire et des affections des voies respiratoires supérieures, *Bull et mem Soc méd d hôp de Paris* **40** 1424 (July 28) 1916.

3 Rist, E. Les principes de diagnostic rationnel de la tuberculose pulmonaire, *Presse med* **24** 305, 1916.

4 Webb, G B, and Gilbert, G B. Bronchiectasis and Bronchitis Associated with Accessory Nasal Disease, *J A M A* **76** 714 (March 12) 1921.

5 Mullin, H V. Fundamental Things Influencing the Infection of the Nasal Sinuses, Ears and Lungs, *Tr Am Acad Ophth*, 1933, p 225.

Peroni,<sup>6</sup> after an extensive investigation of the sinuses of patients with bronchiectasis, concluded that coexisting sinusitis is often primary. When not primary, he believed that the nasal condition is sufficient to augment and protract the disease. Wasson<sup>7</sup> suggested the term bronchosinusitis for infections involving the entire respiratory tract, especially those of a chronic nature. He observed 90 children from birth to the age of 8 years and expressed the opinion that while there is no common etiology this condition is greatly influenced by a lack of vitamins and by heredity, environment, climate and contamination from the air. Opie,<sup>8</sup> in a review of the literature on the pathologic anatomy of influenza from British and American sources, stated that infection of the nasal accessory sinuses appears to be an almost invariable accompaniment of influenzal pneumonia. It is interesting to note also that bronchiectasis has been found frequently as a sequela of influenza.

Clerf<sup>9</sup> suggested that bronchiectasis, when associated with infection of the sinuses, is usually bilateral. Adam,<sup>10</sup> on the contrary, stated that unilateral bronchiectasis occurs with sinusitis.

An interesting observation was made by Graham.<sup>11</sup> He noted the frequent occurrence of acute inflammation of the mucous membrane of bronchial fistulas, which took place about twenty-four hours after the onset of an acute infection of the sinuses. With improvement of the infection of the upper respiratory tract Graham observed that the reaction of the bronchial tissues also cleared up.

#### FREQUENCY OF RELATIONSHIP

Statistics from various centers have shown the association of chronic sinusitis and nontuberculous bronchiectasis to be extremely common. It has been said to vary from 55 to 100 per cent; Clerf reported it in 82.4 per cent of cases, Dunham and Skavlem<sup>12</sup> in 73 per cent, and

6 Peroni, A. Relation of Chronic Diseases of Paranasal Sinuses to Bronchiectasis, *Arch Ital di otol* **44** 385, 1933.

7 Wasson, W. W. Bronchosinusitis Disease, *J A M A* **93** 2018 (Dec 28) 1929.

8 Opie, E. The Pathologic Anatomy of Influenza, *Arch Path* **5** 285 (Feb) 1928.

9 Clerf, L. H. Bronchiectasis Associated with Disease of the Nasal Accessory Sinuses, *Arch Otolaryng* **6** 28 (July) 1927.

10 Adam, James. Bronchiectasis of Inhalatory Origin, *Tr Med-Chir Soc Glasgow* **21** 133 (April 8) 1927.

11 Graham, E. A. The Surgical Treatment of Pulmonary Suppuration in Children, *J A M A* **87** 806 (Sept 11) 1926, Observations on Reaction of Bronchial Fistulae to Acute Infections of Upper Respiratory Tract, *Am J Surg* **14** 382, 1931.

12 Dunham, Kennon, and Skavlem, J. H. Chronic Nontuberculous Infections, *U S Vet Bur M Bull* **3** 861 (Sept) 1927.

Quinn and Meyer<sup>13</sup> in 58 per cent. In a series of 37 patients with bronchiectasis observed at the Montreal General Hospital I found that approximately 75 per cent had associated sinusitis. Like the majority of other authors, I found the maxillary sinus most frequently affected.

Just what the frequency of this relationship indicated is still a subject for discussion. Numerous authors have insisted that sinusitis is the primary cause of bronchiectasis, others have suggested that bronchiectasis is primary. The latter has not, however, been proved. In an effort to check this possibility in 10 patients with bronchiectasis observed at the Montreal General Hospital, I placed a small amount of iodized poppy-seed oil 40 per cent in the trachea. The patients were placed in position and asked to cough. In only 3 patients were traces of iodized poppy-seed oil 40 per cent seen in the nasopharynx in the roentgenogram. Mild silver protein was used in a similar number of patients. Only a few showed any stain in the nasopharynx. No iodized poppy-seed oil or mild silver proteins was found in the nose. During coughing the soft palate seemed a fairly efficient barrier to the entrance of these substances into the nasopharynx. The majority of writers on this subject have expressed the opinion that the whole respiratory tract is simultaneously affected and that, although the bronchitis and pneumonitis have a tendency to clear up, they are kept active by the constant overflow from infected sinuses.

The various routes by which infection of the nasal sinuses may influence the respiratory tract have been frequently referred to. Davis<sup>14</sup> described the following routes:

- 1 Direct extension of the inflammation of the larynx, trachea and bronchi or extension of the infection through the blood and lymphatic streams
- 2 Aggravation or increase of an existing lesion of the lungs
- 3 Existence of nasal sepsis as part of the general infection, in which both the upper and the lower respiratory tracts are involved

Much has been done experimentally to show the relationship of sinusitis and nontuberculous bronchiectasis. The work of Mullin and Ryder<sup>15</sup> has been cited frequently. These authors demonstrated the lymphatic drainage of the maxillary sinuses and their connection with the lungs and also the route of inhalation by which nasal secretions reach the lungs. The work of Pfahler<sup>16</sup> of Philadelphia and of Le

---

13 Quinn, L. H., and Meyer, O. O. The Relation of Sinusitis and Bronchiectasis, *Arch. Otolaryng.* **10** 152 (Aug.) 1929.

14 Davis, E. D. D. The Influence of Naso-Oral Sepsis on the Lungs and Gastrointestinal Tract, *J. Laryng. & Otol.* **43** 465 (July) 1928.

15 Mullin, W. V., and Ryder, C. F. The Studies on the Lymph Drainage of the Accessory Nasal Sinuses, *Laryngoscope* **31** 158 (March) 1921, *Am. Rev. Tuberc.* **4** 683, 1920.

16 Pfahler, G. E. Lymphatic Drainage from Maxillary Sinuses, *Am. J. Roentgenol.* **27** 352, 1932.

Mee and Bouchet<sup>17</sup> of Paris with iodized poppy-seed oil 40 per cent seems to have corroborated these earlier experiments completely. Quinn and Meyer demonstrated the presence of this oil in the thorax after instillation into the nostrils of sleeping patients. And McLaurin<sup>18</sup> showed that after the oil was placed in the antrum it could be demonstrated in the chest by roentgenograms.

These experiments clearly demonstrated that chronic sinusitis must play an important part in infections of the chest and that infection reaches the thorax chiefly by inhalation and by the lymphatic routes.

Some criticism of the latter opinion has been made recently, and there now seems to be a general opinion that the etiologic influence of the sinuses in cases of focal infection has been overemphasized. Childrey and Essex<sup>19</sup> described the mucous membrane of the sinuses as being highly resistant to absorption. Lawson,<sup>20</sup> however, concluded that toxemia associated with chronic disease of the membrane of the sinuses is of great clinical significance and probably originates from the absorption of small quantities of highly virulent toxins generated within the cavities of the sinuses. Kistner<sup>21</sup> and Jones demonstrated streptococci of virulent types in the submucosa of numerous patients with disease of the coronary vessels. Hurd<sup>22</sup> and Snyder expressed the opinion that sinusitis without evidence of discharge is responsible for many cases of serious arthritis. In a recent interesting article Tilley<sup>23</sup> pointed out that frequently there is a residual infection in the bone tissues of the capsule of a sinus and that this is one of the most potent foci for the vascular transmission of septic organisms and their toxins. It is therefore probable that in this type of case and in the so-called silent cases of sinusitis with little drainage absorption from the sinuses to the lungs is most marked. The absence of all symptoms of disease of the sinuses when associated with bronchiectasis has been noted frequently, but I do not believe it has been sufficiently emphasized. Frequently nasal

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17 Le Mee, J. M., and Bouchet, M. Mode d'élimination du lipiodol dans la méthode de déplacement, *Ann d'oto-laryng*, Aug., 1932, p. 919.

18 McLaurin, J. G. Chest Complications of Sinus Disease, *Ann Otol, Rhin & Laryng* **41** 780, 1932.

19 Childrey, J. H., and Essex, H. E. Absorption from the Mucosa of the Frontal Sinus, *Arch Otolaryng* **14** 564 (Nov.) 1931.

20 Lawson, L. J. The Role of Nasal Accessory Sinus Membrane in Systemic Infections and Toxemias, *Ann Otol, Rhin & Laryng* **39** 159 (March) 1930.

21 Kistner, F. B. Chronic Nonpurulent Sinusitis and Its Clinical Significance, *Ann Otol, Rhin & Laryng* **38** 795 (Sept.) 1929.

22 Hurd, Lee M. Chronic Infections of the Nasal Accessory Sinuses, *Ann Otol, Rhin & Laryng* **39** 960 (Dec.) 1930.

23 Tilley, A. Chronic Pyogenic Inflammation of the Antrum and Other Accessory Sinuses, *J Laryng & Otol* **50** 1 (Jan.) 1935.

involvement, when unaccompanied by pain, is not complained of by the patient, and only a thorough examination will disclose infection of the sinuses. Mullin, in reporting on 295 cases, stated that in nearly 7 per cent cough was the only symptom, although well marked infection of the sinuses was present in all. Frequently cases have been reported in which treatment for tuberculosis had been given over a period of years and in which the condition in reality had been sinusitis and bronchiectasis.

Cleif<sup>24</sup> has emphasized an experience that is perhaps common among laryngologists. A patient complaining only of chronic cough and a husky voice is found on laryngeal examination to have chronic laryngotracheitis. A thorough physical examination often fails to reveal evidence of thoracic disease, yet an examination of the sinuses and nose reveals chronic sinusitis. A routine examination of the sinuses should be carried out on all patients with infection of the lower respiratory tract. This procedure would reveal, as many authors have indicated, many unsuspected cases of involvement of the sinuses.

The assumption then is that following sinusitis chronic bronchitis develops and in the course of time, perhaps years, bronchiectasis. The process by which this occurs is not completely understood, and there seem to be many exceptions. Frequently, a patient with involvement of the sinuses, even with pansinusitis, with a history of postnasal discharge and cough for years, is found to have little or no evidence of thoracic disease. Why then do the lungs seem to resist infection in some patients and to succumb so easily in others? The resistance of the individual patient and the virulence of the organism must of course be taken into consideration. Why, also, if this assumption is correct, do chronic sinusitis and bronchiectasis occur in very young children in whom the duration is obviously short? All recent evidence would seem definitely to suggest that some change occurs in childhood which predisposes these patients to subsequent infection of the lungs.

#### INFLUENCE OF ATLECTASIS ON BRONCHIECTASIS

Bronchiectasis has been well described as a disease of childhood. And it is interesting to note in reports of cases the frequency with which patients with bronchiectasis date their symptoms to early childhood.

In recent years authors have described a triangular shadow at the base of the lung in roentgenograms of children. Singer and Graham<sup>25</sup> were the first in America, in 1925, to recognize this shadow as a sign

24 Cleif, L. H. Interrelationship of Sinus Disease and Bronchiectasis with Special Reference to Prognosis, *Laryngoscope* **44** 568 (July) 1934.

25 Singer, J. J., and Graham, E. A. Roentgen-Ray Study of Bronchiectasis, *Am J Roentgenol* **15** 54, 1926.

of atelectasis and bronchiectasis of the lower lobe Anspach<sup>26</sup> reported a study of 50 of these cases in children He found that when this triangular shadow fluctuated in size and density from one examination to the next only tubular bronchiectasis developed or the chest cleared up with little or no evidence of dilatation of the bronchi When damage did not occur, with frequent reexpansion of the lobe or lobules, saccular bronchiectasis resulted The latter condition developed in the finer, more distal, bronchi, in which thick secretion easily produced complete obstruction Anspach expressed the opinion that allergy may aid in bringing about the initial obstruction by the swelling of the mucous membrane and the production of a thick, tenacious secretion

Like other writers, Anspach<sup>26</sup> suggested that atelectasis is the precursor of bronchiectasis in adults Frequently, permanent damage occurs in the lung in early infancy, and even though dilatation does not occur, the bronchi are left in a weakened condition This, he suggested, aids in the development of bronchiectasis and associated clinical symptoms in adult life The research study by Robinson<sup>27</sup> of Toronto, who reported on the pathologic changes following lobectomy for bronchiectasis in 16 cases, would seem to corroborate this view

It is therefore interesting that since the advent of pneumography and the widespread use of iodized poppy-seed oil 40 per cent, various writers have shown that dry bronchiectasis exists, as evidenced by bronchial dilatations This has been noted in both children and adults Wall and Hoyle,<sup>28</sup> in citing 30 cases from the literature and reporting on 20 of their own cases observed in two years, concluded that dry bronchiectasis is extremely common and that the great danger lies in the development of wet bronchiectasis

#### INFECTION OF THE RESPIRATORY TRACT AS A WHOLE

There has been a tendency among a number of writers to describe infections of the mucous membrane of the respiratory tract as separate entities instead of as a whole The reaction of the mucous membrane to infection is much the same, whether in the nose or in the thorax It is interesting, therefore, in a case of fetid bronchiectasis to find changes in the mucous membrane similar to those seen in the nose in a case of atrophic rhinitis with ozena Both conditions have been attributed to a multitude of bacteria, while numerous theories have been cited to describe the etiology Current investigation is helping to increase the

26 Anspach, W E Atelectasis and Bronchiectasis in Children, *Am J Dis Child* **47** 1011 (May) 1934

27 Robinson, W L Bronchiectasis A Study of the Pathology of Sixteen Surgical Lobectomies for Bronchiectasis, *Brit J Surg* **21** 302 (Oct) 1933

28 Wall, C, and Hoyle, J C Observations on Dry Bronchiectasis, *Brit M J* **1** 597, 1933

knowledge of the reaction of the respiratory tract to allergy. Bronchiectasis has been produced in guinea-pigs experimentally by causing a deficiency of vitamins. And the investigations of Dean<sup>29</sup> and Hetler have shown that deficiency of vitamin A will cause sinusitis in monkeys but that a diet high in vitamins and deficient in protein will produce both suppurative sinusitis and otitis. While specially planned diets have been shown to be of great value in the treatment of infection of the upper respiratory tract, Dean emphasized that disease of the sinuses cannot be cured by diet alone. Fenton<sup>30</sup> showed experimentally that in a well nourished cat a special diet will not arrest acute sinusitis or prevent its development into chronic sinusitis.

The histiocyte system has been found by Fenton and his co-workers to take up early defensive measures in the membrane of the sinuses and of the ears during an acute invasion or an acute exacerbation of a chronic process. Plasma cells have been found to the exclusion of histiocytes in all late and chronic stages of inflammation and repair.

Sippe<sup>31</sup> in a recent article suggested that hypoglycemia and ketosis may play a part in chronic disease of the antrum and bronchiectasis in both children and adults. He reported 9 cases, 3 early cases in which complete relief of symptoms occurred and 6 advanced cases in which there was considerable improvement following the administration of dextrose. While the number of cases is too small to permit one to draw any conclusions, Sippe suggested that many of the persons who have chronic sinusitis and pulmonary fibrosis have an exudative diathesis as the basis for the development of lesions of the respiratory tract. Frequently this inability to retain water in the tissues is due to an insufficient supply of available dextrose, as evidenced by hypoglycemia or ketosis.

While it is true that there are many exceptions, all the present evidence tends to show that suitable soil is developed in early childhood for subsequent infections of the respiratory tract. Sinusitis which takes part in the involvement of the whole respiratory tract may date from infancy, the constant overflow of secretion being sufficient to keep the bronchial condition active. Or sinusitis due to influenza or to the infectious diseases occurring in later life finds in the bronchial mucous membrane a soil suitable for the development of bronchiectasis. While some patients with bronchiectasis do not show any evidence of sinusitis even after the most thorough examination, the possibility that infection

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29 Dean, L. W. Relationship Between Diseases of Nose (Chiefly Allergic) and Throat and Pulmonary Diseases, *J. Missouri M. A.* **31** 13, 1934.

30 Fenton, R. A. Recent Discoveries in the Pathology of the Nasal and Animal Mucosa, *Canad. M. A. J.* **32**:147 (Feb.) 1935.

31 Sippe, Clive. Hypoglycaemia and Ketosis. Relationship to Chronic Antral Disease and Bronchiectasis, *M. J. Australia* **1** 675 (May 26) 1934.



of the sinuses might have been present at some time cannot be excluded. In view of the more recent knowledge, it is perhaps reasonable to assume that in patients with bronchiectasis the sinuses share the primary infection of the whole respiratory tract. Owing to good drainage, the upper portion of the tract clears up, while the extreme degree of pneumonitis present prevents the lower portion from clearing. Considerably more investigation is needed to decide just what part allergy or hypoglycemia plays in sensitization of the whole tract to infection.

#### TREATMENT

Discussion of the treatment of bronchiectasis is beyond the scope of this paper. There is, however, general agreement that once bronchial dilatation has occurred, only radical surgical intervention, which unfortunately still has a high mortality rate, is successful in curing this condition. And while operation on the nasal accessory sinuses will not cure bronchiectasis, any focus should be, when possible, removed before surgical treatment of the lung is instituted.

It is in children that the best results are obtained from conservative treatment, and this should be commenced early. The upper respiratory tract should receive active treatment. This usually means relief from mechanical obstruction, resulting in free drainage. Bronchoscopic suction, postural treatment and vaccine therapy all have their part. A child with sinusitis who has frequent attacks of bronchitis and pneumonia should be regarded as having potential bronchiectasis. He should be carefully guarded so far as climate, diet, contamination from the air and work are concerned, in order to protect the respiratory tract from further infection.

#### SUMMARY

1 The association of nontuberculous bronchiectasis and infection of the paranasal sinuses is extremely common.

2 Pulmonary collapse and pneumonitis, frequently noted in early childhood, so weaken the structure of the lungs that there is a suitable soil for subsequent infection.

3 Bronchiectasis, as evidenced by the number of dry cavities reported in the lungs of both children and adults, is more frequent than was previously supposed.

4 Infection of the sinuses associated with bronchiectasis may date from early childhood or may occur as a secondary infection in later life.

5 The treatment of bronchiectasis is surgical. Any focus of infection should be, when possible, removed from the upper respiratory tract before surgical intervention on the lungs is attempted. Best results will be obtained from medical treatment if it is commenced in early childhood.

## ABSTRACT OF DISCUSSION

DR E. G. GILL, Roanoke, Va. The interrelationship of disease of the sinuses and bronchiectasis is generally recognized and accepted by otolaryngologists. However, in summarizing this paper I find that problems of this disease still exist that are open for discussion, some of which are: 1 Is bronchiectasis always unilateral, or is it sometimes bilateral when associated with infection of the sinuses? 2 Are the paranasal sinuses ever infected secondarily in patients suffering from bronchiectasis? 3 To what extent does atelectasis influence the development of bronchiectasis? 4 Is absorption of infection from the sinuses to the lungs more marked in the so-called silent cases of sinusitis with little drainage or in the cases of sinusitis with profuse drainage? 5 On the basis of an accepted relationship between bronchiectasis and sinusitis, why is it that some patients have infection of the sinuses, postnasal discharge and cough without having bronchiectasis? 6 Does a deficiency of vitamins in the diet have a part in the development of bronchiectasis in children? 7 To what extent does allergy influence the development of bronchiectasis?

The incidence and the early diagnosis of these diseases can be determined only through the intimate cooperation of the otolaryngologist, pediatrician, internist, bronchoscopist and roentgenologist. The laryngologist should always have in mind the possibility of an infection of the lower respiratory tract in patients suffering from disease of the sinuses and the internist and pediatrician should consider infection of the sinuses as an etiologic possibility in cases of unexplained cough.

The diseases of childhood, such as measles, whooping cough, scarlet fever and influenza, are frequently complicated with infection of the sinuses and bronchitis, and the attending physician should not allow the general systemic condition to overshadow the symptoms of sinusitis. Some observers of these diseases have found that many patients give a history of cough following one of the diseases of childhood and that the initial attack of infection of the sinuses occurs at the same time. For this reason they believe that sinusitis and bronchitis are often of simultaneous origin. Acute infection of the sinuses complicated with laryngotracheobronchitis always leaves permanent pathologic changes in varying degrees in the involved mucous membranes, thus rendering the patient susceptible to subsequent attacks of infection. One should be as alert in the prevention and treatment of this type of infection as one is when dealing with scarlet fever, iritis or typhoid.

When one considers the unsettled problems of these diseases, the number of patients who are being treated for pulmonary tuberculosis when in reality they have bronchiectasis with associated infection of the sinuses and the impossibility of effecting a complete cure of chronic bronchiectasis, it behooves the members of the medical profession to use every legitimate means to bring to the attention of patients the importance of prevention, early diagnosis and adequate treatment of these diseases.

DR HERMAN J. MOERSCH, Rochester, Minn. The relationship of disease of the sinuses to bronchiectasis constitutes an interesting problem. Two theories are especially deserving of consideration in all cases of bronchiectasis of unknown origin: (1) the theory so ably discussed by Dr Hodge and (2) the theory that bronchiectasis develops because of some congenital anatomic alteration in the tracheobronchial tree.

A high incidence of disease of the sinuses among patients who have bronchiectasis was referred to by Dr Hodge. Dr Hempstead and I found in a review of 245 consecutive cases of bronchiectasis that disease of the sinuses was present in only a third, this is a much lower incidence than generally is reported.

An observation that would seem to demonstrate a close relationship between infection of the sinuses and bronchiectasis can be made readily in cases of bronchial fistula. Ordinarily there is only a small amount of mucoid secretion from the fistula. Within twenty-four hours after the development of infection of the upper part of the respiratory tract the mucous membrane of the fistula becomes red and swollen and the secretion becomes purulent.

Certain observers, however, have expressed the opinion that bronchiectasis occurs primarily because of a congenital anatomic alteration in the tracheo-bronchial tree and that it manifests itself only when hemorrhage or some secondary, intercurrent pulmonary infection takes place. They have called attention to the dry type of bronchiectasis that may remain dormant for years, then suddenly manifest itself in the presence of hemorrhage and immediately display all the characteristic signs of bronchiectasis in the absence of infection.

With reference to the value of treatment in bronchiectasis, it is important to distinguish between anatomic and clinical improvement. It is doubtful whether a patient who has definite anatomic bronchiectasis will give evidence of marked change in the anatomic status after the infection of the sinuses is eliminated. For clinical improvement, however, there is a more hopeful outlook.

Although it was with considerable skepticism that Dr. Hempstead and I anticipated benefit from the elimination of infection of the sinuses to our surprise 50 per cent of the patients operated on felt that they had obtained benefit. An interesting feature, however, was that in some of the cases in which clinical benefit resulted there was slight or no change in the physical findings.

It is imperative that the sinuses be thoroughly investigated in all cases of bronchiectasis, and if infection is definitely present it should be eliminated. It is important, however, that great care be exercised in operation on the sinuses in cases of bronchiectasis unless infection is definitely present, because otherwise a valuable procedure may easily be brought into general disrepute.

DR. FRANK R. SPENCER, Boulder, Colo. This disease concerns otolaryngologists, pediatricians, internists, bronchoscopists and in some instances even the general surgeon. During the Great War physicians in the service had orders from the Surgeon-General's office concerning infections of the lungs and their relationship to disease of the sinuses. Many soldiers in the trenches were sent back to a base hospital with a diagnosis of possible pulmonary tuberculosis. Many of them did not have pulmonary tuberculosis, they had a nontuberculous infection often due to disease of the sinuses.

About that time the late William V. Mullin did excellent work in demonstrating the lymphatic drainage from the sinuses and the importance of this drainage in spreading infection from the sinuses. A more recent paper by Dr. Mullin was a report of a large series of cases of bronchiectasis, which substantiated the earlier observations.

In Colorado one sees three groups of patients who have bronchiectasis. In the first group are patients who do not have any disease of the sinuses. It is possible that they had disease of the sinuses in early childhood and made a complete recovery, either with or without treatment. In the second group are patients who have definite bronchiectasis and definite disease of the sinuses. It seems likely that disease of the sinuses is the cause of the bronchiectasis. I believe that these patients show some improvement when the disease of the sinuses is properly cared for, but they are not cured, because once the bronchiectasis becomes well established it has a decided tendency to become gradually worse as the years go by. In the third group are patients who have not only disease of the sinuses but bronchiectasis and

slight pulmonary tuberculosis Quite a few of these patients are sent West with a diagnosis of pulmonary tuberculosis Bronchiectasis has not been recognized, and the pulmonary tuberculosis plays only a minor part in the patient's disease and in the general care that these patients need

DR MYRON METZENBAUM, Cleveland The paranasal sinuses are evolved at birth The antrums, which are well developed after the fifteenth month, are relatively large cavities in the infant Severe infections of the mucous membranes of the upper respiratory tract may and frequently do involve the mucous membrane linings of the nasal accessory sinuses Influenza, bronchitis, pneumonia, the common head cold, scarlet fever and measles, the swimming pool and the bathing beach are all potent factors in the development of infections of the sinuses

A chronic purulent infection of the antrums results in marked thickening of the mucous membranes and often in polypoid degeneration, even in young children Thus pathologic change is demonstrable in roentgenograms with or without the introduction of iodized poppy-seed oil 40 per cent and at the time of surgical intervention on the antrums

Aspirated secretions from the antrums cause bronchial irritation which may result in bronchiectasis with or without asthmatic attacks Treatment for bronchiectasis resulting from a definite infection of the antrum includes the establishment of permanent ventilation and drainage of the infected antrum and when indicated removal of the pathologic changes within the antrum

In children, dry suction removes the plugs of secretion from the ostia and the secretion from all the cells, thereby establishing ventilation and drainage simultaneously to all the infected sinuses When these methods fail, surgical intervention becomes necessary

In children the Caldwell-Luc operation destroys the buds of the unerupted teeth Therefore one should perform an intranasal window resection and remove the lining of the antrum when a pathologic process is present This procedure usually results in an amelioration of most of the symptoms in cases of bronchiectasis of not too long standing due to infection of the antrum and may result in a cure in those cases in which no secondary pulmonary changes have taken place

DR GEORGE E. HODGE, Montreal, Canada I have little to add on this subject other than to thank my colleagues for their criticism and suggestion As Dr Moersch stated, the point may again be emphasized that statistics from various parts of the world show the universal frequency with which infection of the sinuses is associated with bronchiectasis I do not believe that this fact can be discounted by any one I was surprised, therefore, in listening to a discussion on bronchiectasis at the meeting of the Section on Practice of Medicine, to note that no comment was made on the relationship of sinusitis to bronchiectasis

# NEOPLASMS INVOLVING THE MIDDLE EAR

LEROY A SCHALL, MD

BOSTON

In no field of otology is there so much confusion as in the treatment of neoplasms of the middle ear. The general attitude has been that radical mastoidectomy should be performed but that the outlook is hopeless and the patient doomed.

The literature is scanty. The older literature refers to malignant growths of the middle ear as medical curiosities. Newhart<sup>1</sup> stated that he found reports of only 8 cases in the American literature. Keeler<sup>2</sup> in 1922 thoroughly reviewed the literature and compiled 60 instances and added 2 of his own. Since 1922, Barnes,<sup>3</sup> Furstenberg,<sup>4</sup> Lewis,<sup>5</sup> Burton<sup>6</sup> and Fraser<sup>7</sup> have presented reports of cases.

## INCIDENCE

In the past twelve years 15 patients with neoplasms involving the middle ear were seen by the otologic staff of the Massachusetts Eye and Ear Infirmary. Three of these patients are now living—two, four and nine years, respectively, after treatment. In the same period 90,040 patients with pathologic conditions of the ear were seen at this hospital, so in this series the incidence was 1 in 6,000 cases of disease of the ear.

This paper is based on personal experience in 6 cases—2 from the series of the Massachusetts Eye and Ear Infirmary, 3 from the Collis P. Huntington Memorial Hospital and 1 from private practice. They were equally divided between the sexes, all the patients were past 45.

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Read before the Section on Laryngology, Otology and Rhinology at the Eighty-Sixth Annual Session of the American Medical Association, Atlantic City, N. J., June 12, 1935.

1 Newhart, Horace. Primary Carcinoma of the Middle Ear. Report of a Case, *Laryngoscope* **27** 543 (July) 1917.

2 Keeler, J. Clarence. Some Remarks on Otitic Malignancy, *Tr. Am. Laryng., Rhin. & Otol. Soc.*, 1922, p. 25.

3 Barnes, E. B. Carcinoma of the Ear, *Proc. Roy. Soc. Med.* **23** 1231 (June) 1930.

4 Furstenberg, A. C. Primary Adenocarcinoma of the Middle Ear and Mastoid, *Ann. Otol., Rhin. & Laryng.* **33** 677 (Sept.) 1924.

5 Lewis, Fielding O. Case of Cancer Involving the Larynx, Tonsil and Ear, *S. Clin. North America* **7** 365 (April) 1927.

6 Burton, F. A. Epithelioma of Middle Ear and Mastoid. Report of a Case, *Laryngoscope* **27** 755 (Oct.) 1927.

7 Fraser, J. S. Malignant Disease of the External Acoustic Meatus and Middle Ear, *Proc. Roy. Soc. Med.* **23** 1235 (June) 1930.

## TYPES OF TUMORS

The following types of neoplasms were represented

	No of Cases
Basal cell carcinoma	2
Adenocarcinoma	1
Epidermoid carcinoma, grade 4	1
Hemangio-endothelioma	2

## SYMPTOMS AND DIAGNOSIS

The most constant findings, although it may have but a casual relationship, is chronic otorrhea. The symptom most suggestive of neoplasm is the tendency to bleed from the external auditory canal. This bleeding may be of any degree of severity from a blood-tinged discharge to severe hemorrhage after removal of granulations or an aural polyp. Pain may be an early symptom, but usually it does not occur until the growth has attained sufficient size to cause pressure. Facial paralysis occurred early in 2 cases of this series. In the early stage there may be no symptom suggestive of neoplasm except the finding of an "aural polyp" on clinical examination. The removal of this "polyp" is followed by excessive bleeding. Microscopic examination of the specimen reveals the true diagnosis. This was true in 2 of my cases. Therefore, I believe that if every aural polyp were studied microscopically the early diagnosis of a malignant growth would be made more frequently.

In the early stage the roentgenogram may be of no diagnostic value. In a case of hemangio-endothelioma in which the roentgenograms revealed nothing abnormal, extension of the tumor to the deep posterior canal cells was found at operation.

## TREATMENT

In the older literature the treatment reported for malignant conditions of the middle ear was strictly surgical. The mortality rate after surgical treatment alone was so high that the pessimistic attitude of the otologists of that period can be readily appreciated.

The use of irradiation alone has been disappointing. Robinson<sup>8</sup> in 5 cases of malignant growth of the middle ear obtained no cures by radium therapy. Ullmann<sup>9</sup> used irradiation for the treatment of malignant conditions of the ear, but he gave no statistics. In the external use of irradiation the clinical fact is ignored that even with a dosage sufficient to cause necrosis of the bone it may have no effect on the tumor invading the bone.

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<sup>8</sup> Robinson, G. Allen. Malignant Tumors of the Ear, *Laryngoscope* **41** 467 (July) 1931.

<sup>9</sup> Ullmann, H. J. Treatment of Ear Malignancy, *California & West Med* **37** 369 (Dec.) 1932.

Conservative surgical procedure has no place in the treatment of aural neoplasms. Given a positive result of biopsy on a lesion beyond the isthmus of the external auditory canal, I contend that the site of origin cannot be determined by clinical examination. I believe, therefore, that a neoplasm in the external auditory canal beyond the isthmus is a potential malignant growth of the middle ear and should be treated as such by the following procedures:

1. Wide removal of the growth by excision of the entire cutaneous canal. Any surgical procedure less radical than the removal of the entire cutaneous canal is inadequate. Except in case of external lesions, the use of electrocoagulation in the canal, either for removal of a growth or for the excision of a part of the canal, has been followed by

*Results of Treatment in Six Cases of Neoplasm Involving the Middle Ear*

Case	Diagnosis	Structures	Treatment	Status of Patient	Time Since Treatment
1	Epidermoid carcinoma grade 4	Middle ear, mastoid, sternocleidomastoid muscle	Radical mastoidectomy, radium therapy, resection of sternocleidomastoid muscle	Dead	3 mo
2	Hemangioendothelioma	Middle ear, canal	Radical mastoidectomy, irradiation, radium therapy	Living, no recurrence	4 yrs
3	Hemangioendothelioma	Middle ear, canal, mastoid	Radical mastoidectomy, irradiation, radium therapy	Death from pneumonia, no recurrence of tumor	2 yrs
4	Basal cell carcinoma	Canal, middle ear	Radical mastoidectomy, radium therapy, irradiation	Living, no recurrence	2 yrs, 9 mo
5	Adenocarcinoma	Canal, middle ear	Radical mastoidectomy, irradiation	Living, no recurrence	4 yrs, 2 mo
6	Basal cell carcinoma	Canal, middle ear	Radical mastoidectomy, radium therapy, irradiation	Living, no recurrence	3 yrs, 2 mo

too many recurrences to be justified. Sufficient current to destroy the tumor may likewise be enough to destroy the underlying bone and produce necrosis.

2. Radical mastoidectomy. This operation should be performed for inspection of the middle ear and the cavity of the mastoid and to secure sufficient space for the proper application of radium. In the case of a growth internal to the isthmus of the canal, I repeat, its origin cannot be determined by clinical examination. Only by radical mastoidectomy can involvement of the middle ear be excluded. The prognosis in cases of undiagnosed malignant growth of the middle ear is too grave for one to neglect the utilization of every possible procedure in order to arrive at a correct diagnosis. The records of cases in the older literature are tragic pictures of the results of late diagnosis.

With 2 patients I followed the technic given in textbooks and left the postaural mastoidectomy incision wide open. At the suggestion of

Dr. Edwards W. Heiman, I removed the concha and cutaneous canal of a patient with a small diploic mastoid, and by elevating the periosteum over the mastoid I had an excellent exposure for radical mastoidectomy. I have now used this approach in 4 cases.

3. **Irradiation.** Radiation to be effective must be applied at the site of the lesion. Sufficient space for the proper application of radium can be obtained only by a radical mastoidectomy. Radium in the form of platinum needles with a wall 0.5 mm. thick, protected by from 0.5 to 1 cm. of gauze, is used. Depending on the type of tumor, a total dosage of from 600 to 1,000 milligram hours is employed. This dosage has caused neither excessive necrosis of the bone nor cerebral damage.

#### CONCLUSIONS

1. Neoplasms of the middle ear are not medical curiosities.
2. Every bleeding aural growth should be suspected of being malignant until microscopic examination proves otherwise.
3. A malignant growth presenting itself beyond the isthmus of the external auditory canal is a potential lesion of the middle ear.
4. Radical mastoidectomy with removal of the entire cutaneous canal is indicated in every case of malignant growth presenting itself in the external auditory canal beyond the isthmus. This procedure is to be followed by irradiation.
5. That 5 patients have had no recurrence for from two to more than four years after treatment of neoplasm of the middle ear is proof that the prognosis in the disease is no longer hopeless.

#### ABSTRACT OF DISCUSSION

Dr. B. H. SHUSTER, Philadelphia. Dr. Pfahler, who has had a large experience with malignant conditions, could find in his records only 4 cases that came under his observation. At one time his search of the literature revealed 1 instance in 40,000 cases of chronic conditions of the ear. Dr. Schall's record, 1 case in 6,000, may signify that the condition is overlooked. This is even more important in view of the fact that some patients recovered when properly treated. Some years ago one of the men on the hospital staff suspected that in some cases chronic discharge from the ear was due to the Vincent organism. He soon found 3 or 4 cases in which the condition cleared up rapidly with change of treatment. Dr. Schall suggests that in his cases bleeding was a significant symptom. Dr. Pfahler's patients suffered unexplainable pain in the ear for varying lengths of time. All the writers agree that malignant conditions seem to develop on the basis of inflammation. In his textbook (1893) Gruber stated that the outcome in the reported cases of sarcoma was always fatal, the growth being rapid. In cases of epithelioma recovery was reported when the growth could be radically removed. This observation is in line with Dr. Schall's suggestion of radical mastoidectomy before the application of radium. Dr. Pfahler reported 2 cases in which there was recovery, 1 of epithelioma and 1 of sarcoma treated with radium alone.



DR JOSEPH BECK, Chicago It is important not to confuse these neoplasms with the malignant lesions of the ear external to the isthmus. In other words, there are many cases of carcinoma and epithelioma of the external ear or even of malignant growth within the concha. In cases of a neoplasm arising from the region between the isthmus and the middle ear, it is impossible to make a clinical diagnosis of the condition of the middle ear. I have observed 2 cases of malignant tumor of the middle ear in more than thirty-five years. One occurring prior to knowledge of roentgenography as an aid in diagnosis or treatment was a case of malignant hemendotherioma, in which facial paralysis was the first symptom. In the second case, a recent one, the management was exactly as Dr Schall indicated. He has spoken of the method of attack, and he has several pictures. I think he could do no better than to show some illustrations of the method of procedure. I should like to know whether his patients are still alive five years from now. Four years is a splendid record, but not a sufficiently long period when one is speaking of complete recovery. The patients are still young.

DR GEORGE M COATES, Philadelphia No physician sees enough of these patients and in a sufficiently short period to elaborate satisfactorily the technic of the management of the condition. Dr Schall has been fortunate in seeing 6 in a comparatively short time and in working out his method of treatment. It is probably true that growths internal to the isthmus cannot be entirely differentiated from those of the middle ear only. And it is also true that some neoplasms arising just outside the isthmus and extending in and past the isthmus fall more or less into the same category. There can be no question that the more radically a growth of this type is removed in any part of the body the better the chance of success, and Dr Schall's method seems to offer a first-rate opportunity of getting rid of these growths before they have progressed too far. I have had a case of a growth that originated near the isthmus and extended inward. I do not think that it could be classified as growing outward from the middle ear. The growth was removed as completely as possible by electrocoagulation followed by irradiation, a procedure which Dr Schall condemns, for the deeper growth at any rate, and properly, I think. This case occurred two or three years ago, and the patient is still alive and without evidence of recurrence at present. Another growth was deeper. It was classified as a malignant condition of the bony canal with probable involvement of the middle ear. This patient underwent a radical mastoidectomy, followed by irradiation, and as far as I know, although I have not seen him for a year or more, he is still alive. I think a biopsy is of the utmost importance in every case in which neoplasm is suspected, and probably should be suspected in many more instances than it is. When the patient comes into the dispensary with a chronic discharge of the ear, polyps or granulating tissue, it is easy to forget that a malignant process is possible. So many growths are seen which are not malignant that I am afraid one may overlook those that are. In my 2 cases the process was in a very early stage. I may have overlooked some in which the disease was more advanced.

DR FRANK SPENCER, Boulder, Colo Benign polyps are less likely to bleed. These are seen rather frequently, the malignant ones, rarely. Hemorrhages or bleeding polyps should arouse suspicion, they demand thorough microscopic study. As one member remarked, one is likely to neglect a tumor which is believed to be benign, and in that one is careless. Swelling of the external auditory canal after the removal of a polyp which persists in spite of treatment should put one on guard. Prolonged treatment only delays the proper diagnosis and makes prolongation of life by a radical operation less likely. Radical surgical intervention for the middle ear and mastoid offers the best means of prolonging life, especially

if surgical treatment is followed by high voltage roentgen therapy or radium therapy or both, depending on the judgment and experience of the radiologist. I have had a case of carcinoma of the middle ear and have observed the treatment employed by my colleagues in several others. All these instances represented late stages, that is, the patient was not seen by an otologist until late in the disease. I want to stress the point that diagnosis is too often made late, not always by an otologist but because the attending physician believes that hemorrhage signifies only benign granulations.

DR LEROY A. SCHALL, Boston. In response to Dr. Beck's request, I will show the slides of my operative procedure. I included them in my original paper but eliminated them in order not to confuse the issue. My paper deals with neoplasms of the middle ear, not methods of operation.

# GLOSSODYNIA REFLEX IRRITATION FROM THE MANDIBULAR JOINT AS THE PRINCIPAL ETIOLOGIC FACTOR

STUDY OF TEN CASES

JAMES B COSTEN, M D

ST LOUIS

During the observation of ninety patients with neuralgia and aural symptoms associated with destruction and disturbed function of the temporomandibular joint, ten were found to have burning pain about the tongue and pharynx. One varied the description to a "prickling sensation along the margin of the tongue." Complete relief was obtained in most of these patients after repositioning the lower jaw to increase its vertical dimension and bring the condyle out of range of the auriculo-temporal and chorda tympani nerves. The relationship and reflex path for the pain seem clear.

Prinz and Greenbaum<sup>1</sup> have stated very recently that nothing definite is known of the cause of glossodynia, ascribing it to endocrine disorders, disturbances of the reticulo-endothelial system and to abnormal acid conditions of the stomach. The relationship of gumma in cases of syphilis involving the central nervous system is obvious from the relief experienced after antisiphilitic treatment. It is interesting, however, to note how frequently glossodynia has been described in the earlier medical literature without any definite accounting for the etiology.

Butlin,<sup>2</sup> in 1885, described "lingual neuralgia" as of idiopathic origin, with pain along the distribution of the lingual and glossopharyngeal nerves and, in one patient, "behind the anterior half arches of the palate as the chief seat of suffering." He stated that the pain, sharp and lancinating, grinding or aching, "may occur in paroxysms, with intervals of complete ease, but it is more commonly persistent, although it is apt to be aggravated by every movement of the tongue, whether in eating or in speaking." Quoting further

There can be little doubt that the tongue may be the seat of rheumatic pain, for Chomel has recorded an unequivocal instance                      the pain was seated in

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From the Department of Otolaryngology, Washington University School of Medicine, and the Oscar Johnson Institute

1 Prinz, H., and Greenbaum, S. S. Diseases of the Mouth and Their Treatment, Philadelphia, Lea & Febiger, 1935, p. 459

2 Butlin, H. T. Diseases of the Tongue, London, Cassel & Co., Ltd., 1885, p. 417

the tongue, but was prolonged into the pharynx. It was very sharp, increased by every movement of the tongue, and very much augmented by deglutition. The rheumatic nature of the pain rested on the fact that she was suffering from articular rheumatism at the time of the affection of the tongue, and that the temporo-maxillary articulation was attacked two days before the tongue. The sudden onset and disappearance of the pain also pointed its rheumatic character.

Treatment, according to Butlin, was effected variously by applications of menthol to the surface of the tongue, by division, excision or stretching of the lingual nerve, and by the use of the faradic or galvanic current along the course of the nerve.

According to Blair <sup>3</sup>

The tongue is well supplied with sensory nerves for both taste and common sensation. Tactile sensation is more acute on the tip than on any other part of the body. The sensory supply of the pharyngeal surface and the circumvallate papillae is through the glossopharyngeal nerve from fibers originally derived from the trifacial. This latter nerve supplies also the oral part of the organ directly through the lingual. The taste papillae on the tip, sides and dorsum probably send their afferent fibers through the lingual and chorda tympani nerves. Painful affections of the tongue in the area supplied by the lingual nerve may be accompanied by severe neuralgia deep in the meatus of the ear through the connection of the fifth nerve with the seventh or it may be over the terminal branches of the fifth.

Brown,<sup>4</sup> briefly referred to abnormal function of the temporomaxillary articulation as a source of pain.

Examination of skulls in the cadaver and dried specimens as well as observation and study of the movement of the condyles shows great variation in size and form of the glenoid cavities of different individuals and often on the two sides of the same individual. It may also become an influential factor in the production of pain. There are many cases on record in which trigeminal neuralgia has been relieved by the insertion of suitable plates to hold edentulous jaws sufficiently apart to keep the condyloid and coronoid processes of the lower jaw in right relation to the surrounding parts.

Eleven cases of "burning tongue" were observed by Engman.<sup>5</sup> He described the condition as a subjective one with no gross lesion except enlargement of the normal papillae, the patients were "terror stricken for fear of carcinoma of the tongue." He referred to the observation of Sluder<sup>6</sup> "that lingual tonsillitis may play a causative part as a factor in painful tongue."

<sup>3</sup> Blair, V. P. *Surgery and Diseases of the Mouth and Jaws*, St. Louis, C. V. Mosby Company, 1912, p. 11.

<sup>4</sup> Brown, G. V. *The Surgery of Oral Diseases and Malformations*, Philadelphia, Lea & Febiger, 1912, p. 321.

<sup>5</sup> Engman, M. F. "Burning Tongue," *Arch. Dermat. & Syph.* **1** 137 (Feb.) 1920.

<sup>6</sup> Sluder, G. "Some Clinical Observations on the Lingual Tonsil, Concerning Goitre, Glossodynia and Focal Infection," *Am. J. M. Sc.* **156** 248 (Aug.) 1918.

Under the heading "Neuralgia and Pain in the Tongue," Mead<sup>7</sup> asserted

A large proportion of the sensory nerve disturbances of the mouth are attributable to referred pain arising from terminal nerve irritation in the teeth, gums, tongue, or mouth. Changes affecting the nerve endings of the fifth nerve anywhere along its distribution may be referred to some other connections of the nerve. Referred pain to the tongue may be caused by affections of the thyroid gland. Many patients complain of painful, indefinite sensations in the tongue, for which no cause can be found.

Oppenheim<sup>8</sup> describes "burning tongue" as follows

This symptom—it is doubtful whether we call it an independent disease—consists in parasthesiae, generally a burning, prickling sensation, confined to the tongue or extending to the mucous membrane of the cheeks, jaws, or lips. It may occur in paroxysms or be constantly present, and it may disturb sleep. It is not on the whole a very common symptom, and generally affects women of advanced age. The teeth are almost always absent. The sufferer is usually of a neuropathic constitution. In several cases cancerphobia, i. e., fear of cancer, was present, but it was impossible to decide whether the fear was the cause or the effect of the paraesthesiae. There were no objective symptoms. Pain in the tongue may appear in the initial stage of tabes, and paralytic dementia. Glossodynia should be chiefly treated by psychotherapy.

Grinker<sup>9</sup> states "Burning sensations are common in arteriosclerosis of the vessels of the tongue."

#### REPORT OF CASES

The patients in the following cases gave the history of "burning tongue" in addition to the other complaints for which they were studied. For brevity the results of the general examinations will be noted in detail only when relevant to the neuralgia.

CASE 1—Mrs. A. K., aged 62, for many years had a "raw" feeling in the right side of the throat. She had headache daily over the right eye, behind the right ear and in the occiput. At the end of the day there was a burning sensation in the right side of the nose and tongue which extended at times to the right ear. She had no deafness or dizzy spells.

She was examined on July 24, 1928. The nasal spaces were clear of infection. The lower turbinates were enlarged but not occlusive. In the nasopharynx the right eustachian tube was set forward by a smooth mass about 0.5 cm. in diameter. The mucosa on the surface was not broken. The mass was soft in texture. The pharynx was otherwise normal. The upper and lower molars on the right side were absent. Hearing tests showed normal hearing with bone conduction slightly prolonged. Biopsy of the mass was suggested and refused.

7 Mead, S. V. *Diseases of the Mouth*, St. Louis, C. V. Mosby Company, 1927, p. 233.

8 Oppenheim, H. *Textbook of Nervous Diseases for Physicians and Students*, translated by A. Bruce, ed. 5, Edinburgh, O. Schulze & Co., 1911, p. 1200.

9 Grinker, R. R. *Neurology*, Springfield, Ill., Charles C. Thomas, Publisher, 1934, p. 354.

The diagnosis was chronic right sphenoiditis, chronic secondary pharyngitis, nasopharyngeal tumor on the right side (?)

On Oct 2, 1933 the patient returned. Biopsy was made, and the sections were reported as showing chronic inflammation and lymphadenoid tissue. The mass was still soft and not increased in size. All the molars on the right side, upper and lower, were missing. The right temporomandibular joint was tender to firm pressure, and closure of the jaws as in biting showed slipping of the jaw to the left with wrenching, of the right joint. The soft mass in the nasopharynx, observed through the nasopharyngoscope, was seen to bulge markedly on closure of the jaws.

The patient was sent to her dentist, and upper and lower dentures were fitted into the molar spaces on the right. The last report from her, three weeks later, indicated that there was marked relief from the headache and burning sensation.

CASE 2—Mrs W H B, aged 33, referred by Dr G D Royston, was just beginning her allergic reaction to the fall grasses. In addition to the usual symptoms of sneezing, watery discharge and obstruction of the nose she had regularly a dull headache localized about the ears and radiating to the cheek bones. This daily pain became severe by the end of the day. A burning sensation radiated to the right ear. The onset corresponded with extraction of the lower molar teeth six months before.

She was examined on July 30, 1932. The nasal spaces showed allergic reaction, the throat was normal. The tonsils had been removed. Much dental work had been done. The lower molars on both sides were missing, and the lower incisors closed behind the uppers with an extreme overbite.

The diagnosis was headache from overaction of the mandibular joint, extreme overbite of the jaws, allergy.

On May 20, 1933, the patient returned with the headache more severe. No trace of her seasonal allergy was seen in the nose. She complained of a "full feeling" in the right ear. The examination gave negative results. The eustachian tube was normal. She was again urged to have a proper fitting of the jaw teeth, and this time she did. About one month later, on July 2, she reported that all of her headache had disappeared. It did not return with her hay fever in the fall. On March 1, 1935, she reported that after tedious efforts to reposition the jaw she had no further burning pains.

CASE 3—Mrs S F, aged 58, was treated by Dr G Sluder for nasal infections. She had no further trouble for a number of years. Then she began to have burning in the throat and sides of the tongue. She had morning headaches, an entirely different type of pain, located about the eyes and in the cheeks. There was also pain about the ears. These symptoms improved as the day proceeded.

Examination on July 11, 1934 showed a mild rhinitis. The ears were normal. The upper teeth were absent and she used a plate. There was no plate below, but all the lower molars had been extracted, permitting a wide overbite. The mandibular joints were extremely painful to internal palpation. The condyles were seen to weave and snap on closure of the mouth.

The diagnosis was hyperplastic rhinitis and mandibular joint syndrome.

She was referred to her dentist, who fitted her mouth with new plates, and she was completely relieved of the headache and lingual pain in three weeks.

CASE 4—Mrs E McM, aged 52, was observed in the outpatient clinic and in Barnes Hospital from Sept 2 1933 to Oct 5, 1934. Her record was voluminous. The following abstract was made by Dr Robert Votaw, who enabled me to examine her.

On Sept 2, 1933, she came to the clinic with complaints of "piles, constipation, burning in the mouth and on both sides of the tongue severe enough to disturb her sleep at night", she contemplated suicide because of the constant burning in her mouth and pain in the top of her head, there was occasional stoppage of the left ear

On September 20, after routine study of her condition in the clinic for gastro-intestinal diseases and in the neurologic department, it was diagnosed as anxiety neurosis, achlorhydria, constipation and hemorrhoids. All blood, serologic and urinary studies gave negative results. Hydrochloric acid, an anticonstipation diet, liquid petrolatum and sodium bromide were prescribed. Temporary relief of the left ear was afforded by inflation of the eustachian tube.

On November 7 a gastro-intestinal fluoroscopic series was made following a barium sulphate meal. She was suspected of having pernicious anemia because of the burning tongue. There were no atrophies or blood changes. During this observation she requested hemorrhoidectomy because she had a friend whose burning mouth was relieved by this procedure.

On December 19 she was admitted to Barnes Hospital and hemorrhoidectomy was done. In consultation with the department of otolaryngology the burning pain was temporarily relieved by cocainization of the lingual nerve in the floor of the mouth, after similar treatment of the sphenopalatine ganglion no change was shown. Numerous mouth washes were prescribed.

On March 7, 1934, after roentgen study, she was given a diagnosis of normal gallbladder and gastric motor insufficiency. The conditions underlying other complaints were indeterminate.

On July 22, on her return to the department of otolaryngology, she was suspected of having the mandibular joint syndrome. She was noted to have worn flat upper and lower dentures with a wide overclosure. The dentures had been worn two years but fitted poorly, and the pain was worse after the dentures were obtained. The patient had noted that she could get relief by holding the mouth open or by wearing corks between the teeth. All symptoms of pain were aggravated by talking or chewing. Both mandibular joints were extremely tender to internal palpation, and the condyles were seen to weave and snap on closure of the mouth. New dentures increased the vertical dimension of the jaw 14 mm.

In October she reported several times that she was completely relieved.

CASE 5—Mrs. A. S. aged 42, was examined on Sept 25, 1933. She gave a history of throbbing pain in the right temple beginning in 1928, for which both sphenoid groups were resected. The pain changed to the right occiput, where it remained, with a burning spot on the skin, "sore as if blistered," disturbing her sleep. Two years ago she had a Caldwell-Luc operation followed by regular nasal treatment, without relief. Her weight was reduced from 115 pounds (52.1 Kg) to 90 (40.8 Kg) because chewing radiated a burning pain along the right side of her tongue. Menstruation ceased at the time of her first nasal operation.

Examination showed the ears normal, fork tests gave negative results. The nose showed evidence of a radical removal of all the posterior sinuses and a window in the right antrum.

The diagnosis was hypogonadal headaches, postoperative nasal scars, allergy (?), glossodynia.

After cocainization of both nasal ganglions, she was returned to her physician for study and possibly endocrine gland medication.

On Nov. 2, 1933, she reported that she had had no relief from the nasal treatment and no improvement after one month of endocrine gland medication. It was

noted that she wore very flat dental plates which permitted wide overclosure of the lower jaw. The right mandibular joint was extremely tender. New plates and repositioning of the lower jaw were advised but delayed. This work was finally done in November 1934 and two months later she was entirely relieved of the pain in the head and tongue and had gained 10 pounds (4.5 Kg.)

CASE 6—Mrs. M. D. aged 44, was referred by Dr. A. R. Anneberg after continued study and treatment in the outpatient clinic. She gave a history of a discharge from both ears since childhood. Her headaches over a number of years were originally frontal and later occipital, the pain was present mornings and became worse toward the end of the day, during the past year she also had a burning pain deep in the neck and throat and along the margins of the tongue.

After six months' observation in the department of general medicine and that of otolaryngology she submitted to a radical mastoid operation on the right side because of an acute exacerbation of her chronic otitis (Feb. 18, 1934). On May 5 windows were made in both antrums because of her chronic maxillary infection. The results of both operative procedures were good, but her headache, occipital and frontal, persisted, as well as the burning pain in the tongue. The frontal headache could be relieved by application of cocaine to the middle meatus, but 5 per cent cocaine applied to the nasal ganglion failed to relieve the occipital headache.

A refractive error of the eyes was corrected, the posterior sinuses were treated by displacement, and a course of treatment with anterior lobe pituitary extract was given, without marked improvement.

It was then noted that all the molar teeth were missing and that the temporomandibular joints were extremely tender. The jaws closed with marked overbite. She was referred for extraction of carious snags, and proper dental plates were obtained on June 1, 1935. There was immediate relief from the occipital headache and pain in the tongue, and there was only a trace of the frontal pain when the nose was obstructed.

CASE 7—Mrs. I. R., aged 49, referred by Dr. Roland Klemme, had a painful tic in the right side of the face for about eight years. The pain began with cramping jabs of pain about the right eye, cheek, throat and side of the tongue and in front of the right ear. Injections of alcohol at intervals of from six to nine months were tried, and finally resection of the posterior root four years ago. The major tic was reduced, but there persisted a constant pain about the right eye and into the root of the nose and burning pains in the right side of the tongue and throat. She had had plates fitted after the operative work, but did not wear them. She had frequent attacks of fine "canker sores" on the buccal mucosa and hard palate.

Examination showed the nose and ears normal. The jaw overclosed on inadequate plates, and as it opened the condyles, which had shifted to the left on closure, wove in the loose joint capsule. The right mandibular joint was extremely tender to palpation. A group of small herpetic spots covered the mucosa of the right lower lip.

The diagnosis was postoperative major tic, atrophy of the muscles of the right side of the face, overbite with neuralgia from irritation about the right mandibular joint, herpes.

On June 27, 1935, it was found that, as instructed, she had worn the dentures since her last examination. When asked concerning relief from pain she would not admit that there had been improvement but said that she had pain only about the right eye, there was no further complaint of burning tongue or of pain in other areas. Interposing 4 mm. of test disks increased the comfort in the right



side of the jaws, and she was returned to her dentist for further increase in the vertical dimension

CASE 8—Mrs S S, aged 64, was referred by Dr L Sale because of headache and burning tongue. She had been under his care a number of years for dietary control of diabetes. For the past ten years she had had a dull pain in the right temple growing worse during the day. There was also a constant burning and "metal taste" along the right side of the tongue. She had stoppage of the ears with tinnitus. The dental plates were fifteen years old.

Examination showed the nose and throat normal, the ear drums dull and retracted. The mandibular joints were very loose and were seen to weave on motion of the lower jaw even externally. Internal palpation of the joints showed the right one extremely tender. Test disks measuring 6 mm instantly gave her relief from the headache and lingual pain.

The diagnosis was mild diabetes, glossodynia on the right side, overbite with destruction of the mandibular joints and consequent neuralgia.

On April 1, 1935 she reported all symptoms improved after the jaw had been repositioned with new plates for one month.

CASE 9—Mrs A H, aged 39, referred by Dr L W Dean, gave a history of a drawing sensation in both ears, most marked in the left, with flashes of burning pain into the left wall of the throat, hard palate, cheek and tongue. The attacks were sudden, worse toward the end of the day, and could be brought on by chewing gum. At other times the pain was relieved after eating certain foods. She had been under the care of Dr R P Scholz for various sinus infections for some years. Roentgen studies by Dr Sherwood Moore showed the capsule loose, with definite abrasion of the left condyle.

Examination on May 17, 1935 showed the nose clear of infection and the throat normal. Most of the molar teeth were missing, which allowed a marked overbite, and as the jaws closed the incisors slipped backward and to the right with a movement of the left condyle to the right when the jaws were completely closed. The mandibular joints ground noisily on closing and were quite tender. Test disks between the jaws relieved the burning in the left side in twenty minutes and all of her pain in one hour and forty-five minutes. She was referred to her dentist for proper support to the lower jaw and increase of its vertical dimension.

CASE 10—Mrs E M, aged 38, referred by Dr H L Alexander, was studied completely in the department of internal medicine, and the findings were entirely negative except for neuralgia deep in the ears, extending into the left side of the neck, and a prickling sensation along each border of the tongue, these symptoms becoming worse toward the end of the day. The symptoms were of two years' standing. She associated the attacks with chewing solid food. She had had some nasal treatment with temporary relief, fitting of glasses gave no relief.

Examination showed the nose normal except for low deviation of the septum. The throat and ears were normal. There was definite malocclusion, and the absent molars were replaced by bridges. The mandibular joints, especially the left, were extremely tender to palpation. Externally, when the mouth was open, the condyle could be seen to pass forward completely into the soft tissue of the pterygoid fossa, dimpling the skin deeply in front of the ear. Interposing test disks of 4 mm between the jaws on the left resulted in disappearance of all pain about the ear and tongue. During the test the patient remarked that she had had no saliva for years, and with the jaw supported only a few minutes the saliva returned.

The diagnosis was neuralgia from destruction of the mandibular joints, glossodynia, malocclusion, deviation of the septum to the right.

## COMMENT

The series from which these cases are taken comprises ninety examples of neuralgias and disorders of the ear which show some or all of the symptoms previously described<sup>10</sup> as a mandibular joint syndrome: (a) intermittent impairment of hearing with a sensation of the ears being stopped, tinnitus and dizziness relieved by inflation of the eustachian tubes; (b) headache in the vertex and occiput and deep around the ears and burning sensations in the walls of the throat and in the sides of the tongue and of the nose, later<sup>11</sup>; (c) herpes of the external canal of the ear and buccal mucosa on the side of the neuralgia in about 25 per cent of the cases.

All the patients showed some form of malocclusion with consequent destructive change in the mandibular joint.

Anatomic reasons<sup>12</sup> for the symptoms of the ear were shown in the effect of overclosure of the jaws on the eustachian tubes by compression of the soft tissues. This was demonstrated by section and by manipulation of soft cadaver specimens.

The painful reactions were explained as the result of (a) deep erosion of the bone in the floor of the glenoid fossa and impaction of this thin area next to the dura, (b) pressure on the auriculotemporal nerve by the condyle in its loose motion and (c) irritation of the chorda tympani nerve as it passes within the edge of the glenoid fossa.

The fact that ten cases of 'burning tongue' have appeared in a series of ninety cases of pathologic conditions of the mandibular joint warrants the assumption that the pain in the tongue is produced reflexly by the pressure of the condyle on the auriculotemporal nerve with reference of the pain along the lingual nerve.

The posterior portion of the mandibular nerve or third division of the trigeminal nerve divides into three large branches: the lingual, the auriculotemporal and the inferior alveolar. These are sensory except for a strand of motor fibers in the inferior alveolar branch, which compose the mylohyoid nerve. The lingual branch is the most anterior and supplies the anterior two thirds of the tongue. The inferior alveolar (dental) nerve is the next and largest branch, and supplies the canine and incisor teeth and the corresponding region of the gums. The auriculotemporal branch arises from the posterior portion of the mandibular nerve by two roots which embrace the meningeal artery and

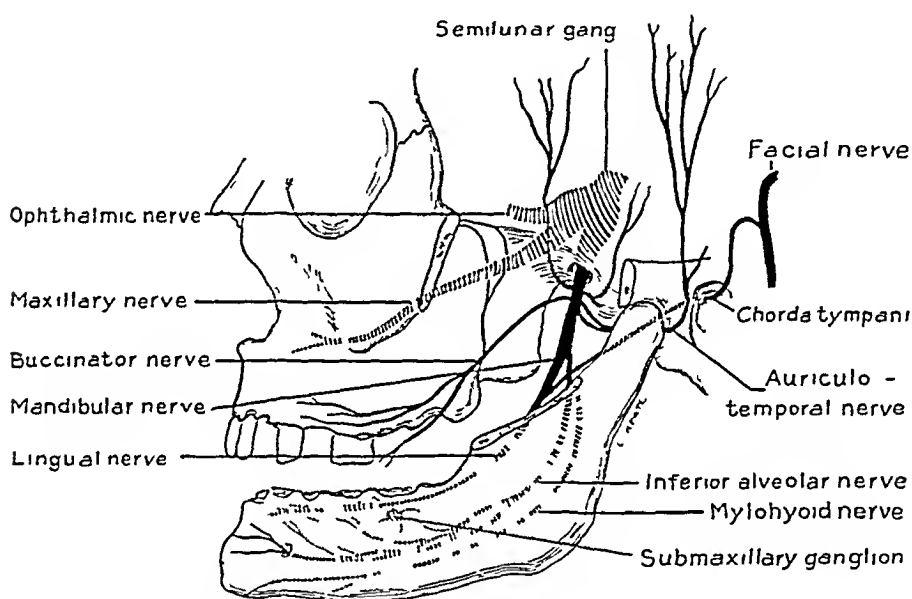
10 Costen James B. A Syndrome of Ear and Sinus Symptoms Dependent upon Disturbed Function of the Temporomandibular Joint. *Ann. Otol., Rhin. & Laryng.* 43:1 (March) 1934.

11. Costen James B. A Group of Symptoms Frequently Involved in General Diagnosis Typical of Sinus and Ear Disease and of Mandibular Joint Pathology. *J. Missouri M. A.* 32:184 (May) 1935.

12 Costen <sup>10</sup> p. 5.

unite behind it to form the trunk of the nerve branch. It passes backward on the inner aspect of the external pterygoid muscle and between the sphenomandibular ligament and the temporomandibular articulation, lying in close relation with the capsule of the joint. Behind the joint it enters the upper part of the parotid gland, through which it turns upward and outward. Its distribution upward corresponds almost exactly to the district to which the pain of inflammation of the sphenoid sinus is referred. It gives off small branches to the capsule of the joint, the external auditory meatus and the parotid gland.

The chorda tympani nerve, an important branch of the seventh nerve is given off in the facial canal, leaving the trunk of the seventh nerve a short distance above the stylomastoid foramen and passing



Schema to show the various areas supplied by the fifth nerve. Reflex pains initiated by irritation of the auriculotemporal and chorda tympani nerves are expressed in these areas. Pain in the tongue occurs along the course of the lingual nerve. Various sensory disturbances arise in the region supplied by the chorda tympani.

upward and forward in the posterior wall of the tympanic cavity. Within the cavity it runs behind the upper third of the tympanic membrane, leaving it by way of the iter chordae anterioris at the inner end of the petrotympanic fissure.

Thus the auriculotemporal nerve has ample chance of impaction by the condyle in a loose joint which has been destroyed through the lack of molar support in an edentulous mouth or through the uneven pressure permitted by maloccluding natural teeth. The tendency of the joint to be destroyed on its weakest margin, i. e., mesially and forward, was

noted and illustrated<sup>13</sup> as producing the mechanism for further play in the joint. Impaction backward, upward or in any direction catches a portion of the auriculotemporal nerve in its course between the condyle and the tympanic plate. Strong irritation of this branch is therefore afforded and reflected to the areas supplied by its terminal branches (deep within the ear, about the ear and in the region of the vertex), to the area supplied by the lingual branch (anterior two thirds of the tongue) and to the area supplied by the inferior alveolar branch (lower incisors, canines, gums and jaw).

After the condition of pathologic joint is suspected as the source by the appearance of malocclusion, overclosure or lack of molar teeth, and palpation of the joint internally<sup>14</sup> shows it to be extremely tender, the diagnosis can be further confirmed by interposing small test disks between the jaws for short periods of time. The effect on the neuralgic pains if they are from irritation by the joint is marked relief from the burning in from ten to forty minutes. The relation can be repeatedly proved by giving the patient a number of cork disks, 2 mm in thickness, with the instruction to place them between the jaws during various attacks and note changes in the pain. The degree of change in a joint which is extremely loosened can be noted when the patient opens and closes the mouth.

Movement of the condyle mesially in the more marked type of loose joint seems to offer the best chance of irritating the chorda tympani nerve. Since its function is chiefly gustatory, one expects to find sensory disturbance rather than pain effects from irritation. The patient in case 8 described "metal taste" and the patient in case 10 "prickling sensation," with and without burning. How much reflex irritation is passed along the chorda tympani and auriculotemporal nerves by way of central nuclei or by way of sympathetic ganglions to the glossopharyngeal nerve awaits further study of cases in which the disorder is diagnosed as glossopharyngeal neuralgia.

The treatment of "burning tongue" has been surgical, as noted early by Butlin,<sup>2</sup> applied to the lingual nerve, and palliative, with use of electric stimulation, cocaine (injected into the lingual nerve in the floor of the mouth) and general measures. Dean<sup>15</sup> and later Sluder<sup>16</sup>

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<sup>13</sup> Costen,<sup>11</sup> figure 9

<sup>14</sup> Costen, James B. Neuralgias and Ear Symptoms Involved in General Diagnosis Due to Mandibular Joint Pathology, *J Kansas M A* **36** 315 (Aug) 1935

<sup>15</sup> Dean, L. W. The Control of Glossodynia, *South M J* **15** 856 (Oct) 1922

<sup>16</sup> Sluder, G. "Lower Half Headache" (Neuralgic) of Nasal Origin. Glossodynia, Otagia, Nausea, Parageusia, Vertigo, Scotoma, Photophobia, Rhinorrhea and Asthma as Isolated Phenomena, *J A M A* **79** 1898 (Dec 2) 1922

reported numerous cases in which the pain was relieved by injection of alcohol into the nasal ganglions. Neurologists recognizing the common attitude of cancer phobia recommended psychotherapy. Anti-syphilitic treatment is indicated when the pain is of that origin.

#### SUMMARY

Ten cases are presented from a large group showing pathologic conditions of the mandibular joint due to various kinds of malocclusion. The chief complaint in each of these cases was of "burning tongue" or glossodynia.

In each of these cases, during the examination, the pain was partially or completely relieved when the condyle was moved away and downward from the joint by interposing test disks between the jaws. The thickness of the disk pack was judged grossly by the looseness of the lower jaw. No other treatment was used in the tests.

The success with which permanent relief was obtained depended on the chance of perfect repositioning of the jaw by dentures which increased its vertical dimension and moved the condyle away from the range of the chorda tympani and auriculotemporal nerves.

Irritation of these nerves, especially the auriculotemporal, sufficient to produce reflex pains in the remaining branches of the mandibular nerve is proposed as the principal etiologic factor in the production of "burning tongue" or "neurosis of the mouth" without gross lesions.

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# EVALUATION OF CALORIC TESTS IN LOCALIZATION OF LESIONS OF THE POSTERIOR FOSSA

A STUDY OF FORTY VERIFIED CASES

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The object of this communication is, first, to evaluate, if possible, the aid that can be obtained for localization of lesions in the posterior fossa by a study of the caloric responses obtained in cases of such lesions and, secondly, to compare the accuracy of such localization with that suggested by a study of the clinical findings in each case

For the purpose of this study we have used cases in which the diagnosis has been verified either by operation or at autopsy and in which the caloric tests were performed by members of the otologic staff of the hospital. We regarded as "verified by operation" only those cases in which the pathologic process was seen or removed by the surgeon, "verified by autopsy" refers only to macroscopic observations made post mortem. We have no evidence as to what the effects of these lesions were on the various pathways, as would be shown if serial sections had been made for the purposes of finer localization.

The entire material was selected from the various services and the neuropathologic laboratory of the Mount Sinai Hospital. The group consists of twenty-two cases of cerebellar lesions (twenty neoplasms, one hemorrhage and one tuberculoma of both cerebellar lobes), seventeen cases of tumor of the pontile angle and one of neoplasm of the pons.

The first group to be discussed will be the cases of cerebellar lesions. There were twelve males and ten females. The ages varied between  $3\frac{1}{2}$  and 53 years. The duration of illness before admission to the hospital varied between six weeks and four years.

The most common symptom in this group was headache. It was the initial complaint in eighteen cases. In nine cases the headache was accompanied by nausea, vomiting and vertigo, and in nine others,

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Read at the meeting of the American Otological Society, Toronto, Canada, May 29, 1935

These patients were observed in consultation with the neurologic staff of Dr I Strauss at the Mount Sinai Hospital and studied by the otologic staff of Dr I Friesner

by nausea or vomiting alone. In three cases ataxia was the first symptom noted, in two others the first sign was diplopia, and one patient stated that vertigo unassociated with headache or vomiting was the first symptom.

On examination of the vestibular apparatus we tested not only the internal ear but also a large portion of the central nervous system. We could determine the intactness of the internal ear and of the eighth nerve as well as of the various afferent pathways and the intracranial structures through which these fibers pass. From these tests we were in a position to state whether the lesion was peripheral or central and, if central, where it was located. In many cases the findings are helpful in reaching a fairly definite localization, especially if studied as they should be, in conjunction with the findings of a neurologist. Levitt<sup>1</sup> expressed the opinion that the term Barany tests should be discarded for "examination of the vestibular apparatus," in other words, the examination of a definite anatomic entity.

In all instances the caloric tests were used instead of the turning tests, as the information obtained from the former is more accurate and reliable since each semicircular canal is tested separately. It must be remembered that the vestibular tests are used as an aid in the localization of a lesion and not in the determination of the nature or type of the lesion present. Our conclusions or impressions as to localization were arrived at independently of the neurologic findings. The vestibular findings elicited by means of the caloric tests are influenced, aside from the presence of the lesion itself, by the question of the degree of intracranial pressure and also by whether or not and to what degree the patient cooperates. To obtain a fair degree of proficiency in the proper evaluation of these tests it is necessary to study as many cases as possible, to standardize the technic carefully and to interpret the findings conservatively and accurately. After the vestibular findings have been noted as carefully as possible, the next step is to analyze these findings and determine by means of knowledge of the vestibular pathways a presumptive localization. Up to the present time our knowledge of these pathways has been based on clinical experience, the result of many examinations and correlative studies of neurologic, operative and post-mortem observations.

The clinical sphere of application of the caloric test is as follows:

- 1 It is a valuable and positive method of ascertaining the degree of viability of the labyrinth.
- 2 It aids in the diagnosis of the presence or absence of a lesion of the cerebellopontile angle.

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<sup>1</sup> Levitt, F. C. The Evaluation of the Vestibular Examination in Intracranial Localization, *Ann Otol, Rhin & Laryng* 34: 574 (June) 1925.

3 It permits an early diagnosis of actual or threatening intracranial invasion in cases of acute or chronic suppuration of the middle ear

4 In cases of neurologic disturbances in which clinical findings are vague, a vestibular examination will frequently elicit definite evidence of an intracranial lesion which would serve to put the neurologist on his guard. When the general neurologic picture is confusing and differentiation between a subtentorial and a supratentorial lesion is not clear on neurologic grounds, a vestibular examination may help in such differentiation. Occasionally it is possible by these tests either to localize the side on which the lesion is present or to help even more definitely in localization.

5 A wide field of application for the tests lies in the diagnosis of the cause of vertigo.

A knowledge of the intracranial pathway of the vestibular nerve, as understood by us at the present time, is important in the proper evaluation of the findings on caloric examination.

In recent years Grahe,<sup>2</sup> Brunner<sup>3</sup> and Kobrak<sup>4</sup> have made detailed studies of cochlear and vestibular examinations and their importance in the recognition of intracranial disease.

Ramón y Cajal has shown histologically that fibers from the vestibular portion of the eighth nerve enter Deiters' nucleus and continue through the inferior cerebellar peduncle into the cerebellum.

The nerve pathways or vestibular tracts have not been entirely defined. From anatomic and physiologic studies and from operative and postmortem observations, these tracts may be said to have a definite course from the labyrinth to the cortical center, supposedly located in the first and second convolutions of the temporosphenoid lobe near the cortical center for hearing. From the various end-organs within the labyrinth, namely, Corti's organ of the cochlea, the maculae of the utricle and saccule and the crests of the three semicircular canals, nerve fibers enter the internal auditory meatus, where they unite in one common bundle to form the eighth nerve. At the point of entrance of the eighth nerve into the medulla oblongata the nerve fibers again divide into two main trunks, namely, the auditory and vestibular portions. The auditory fibers divide into an anterior and a posterior tract. The vestibular fibers divide into fibers of the horizontal canal and those of the vertical canals.

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2 Grahe, Karl. *Hirn und Ohr*, Leipzig, Georg Thieme, 1932.

3 Brunner, H. *Allgemeine Symptomatologie der Erkrankungen des Nervus Vestibularis*, in Alexander, G., and Marburg, O. *Handbuch der Neurologie des Ohres*, Berlin, Urban & Schwarzenberg, 1924, vol 1, p 940.

4 Kobrak, F. *Oto-neurologische Diagnostik*, *Monatschr f Ohrenh* 64:947, 1930.



The original investigations of the vestibular pathways by Jones<sup>5</sup> have been a valuable aid in the localization of intracranial lesions by means of the vestibular tests.

According to Jones,<sup>5</sup> the fibers from the horizontal canal and those from the vertical canals have a different course within the brain stem. The fibers from the horizontal canal go to Deiters' nucleus in the upper part of the medulla and there divide into two separate tracts. The

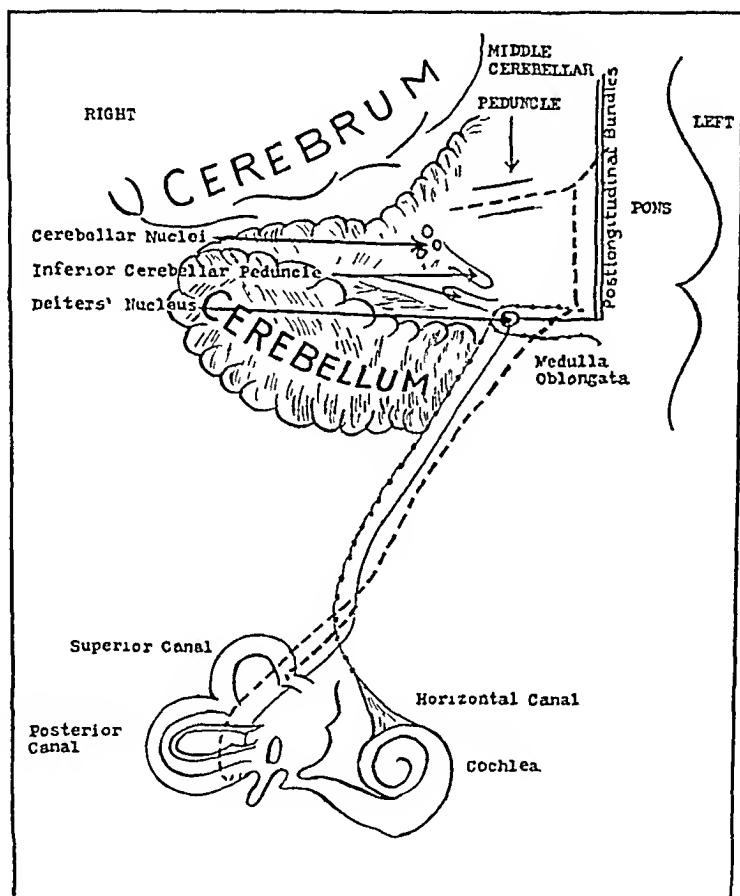


Fig 1—A diagram of the view from the front, showing the pathways of fibers from the cochlea and the horizontal and vertical canals. (This illustration and figure 2 were copied from Jones, I. H. *Equilibrium and Vertigo*, Philadelphia, J. B. Lippincott Company, 1918.)

vestibulocerebellocerebral tract ascends by way of the juxtarestiform body in the inferior cerebellar peduncle to the dentate nucleus in the cerebellum. The vestibulo-ocular tract ascends to the posterior longitudinal bundle and goes to the nuclei of the third and sixth nerves in the pons. The fibers from the vertical canals ascend into the pons and

<sup>5</sup> Jones, I. *Equilibrium and Vertigo*, Philadelphia, J. B. Lippincott Company, 1918.

divide into two tracts. The exact location of this point of division is not known. The vestibulocerebellocerebral tract goes to the dentate nucleus in the cerebellum by way of the middle cerebellar peduncle, and the vestibulo-ocular tract ascends to the nuclei of the third and fourth nerves in the pons. From the cerebellum the fibers reach the

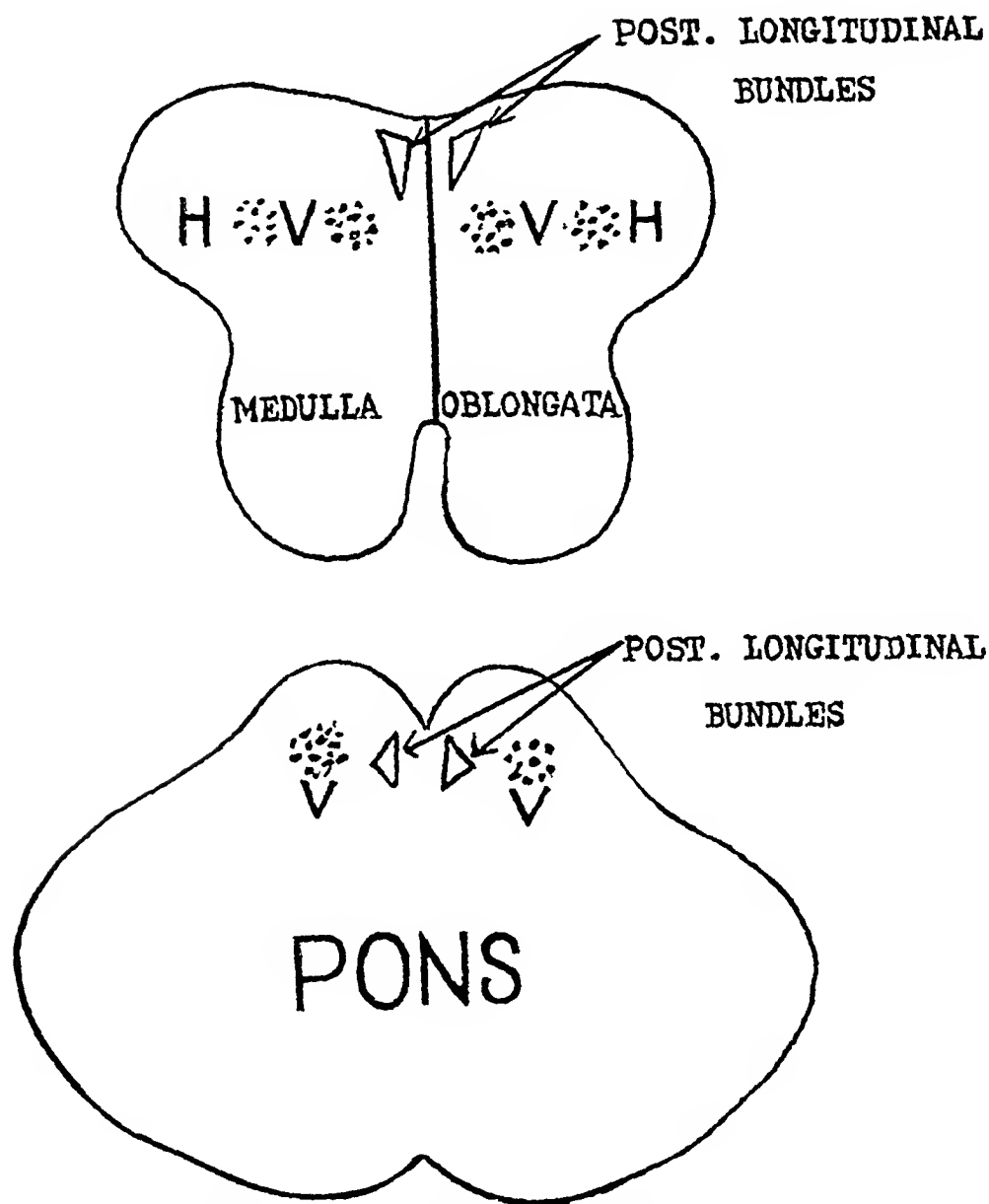


Fig 2—A diagram of cross-sections at different levels of the brain stem, showing the fibers of the horizontal (*H*) and vertical (*V*) canals. There are no fibers of the horizontal canal in the pons.

cortical center in the opposite temporal lobe by way of the superior cerebellar peduncle. This, in brief, is our tentative view as to the central pathway of the vestibular nerve.

A knowledge of the differential diagnosis of a peripheral and a central lesion of the eighth nerve depends on certain general principles

and is of importance in localization by means of hearing and vestibular tests

A peripheral lesion of the labyrinth or eighth nerve is suggested by the following observations. In a case of peripheral lesion all the responses are impaired, and, conversely, the presence of any one normal response to stimulation suggests a normal labyrinth and a normal peripheral portion of the eighth nerve. Spontaneous nystagmus in the vertical plane, either upward or downward, indicates a central lesion. If stimulation produces "perverted" nystagmus, the lesion is probably central.

If the findings lead to the conclusion that the lesion is central, the next problem is to locate the lesion more definitely within the cranium. The facility with which one is able to do this depends in a great measure on how well one is able to visualize the various pathways constituting the vestibular apparatus. The simplest method of procedure is that of elimination. One begins with the labyrinth and proceeds brainward, considering each structure by itself.

#### CEREBELLAR LESIONS

*Nystagmus*—Of twenty-two cases of cerebellar lesion nystagmus was present in fourteen and absent in five and was not noted in three. Spontaneous nystagmus most marked to the side opposite the lesion was noted in seven cases, and spontaneous nystagmus most marked to the side of the lesion was present in four. Spontaneous vertical nystagmus was noted in five cases. Spontaneous past-pointing was present in three cases and absent in thirteen and was not mentioned in six.

*Hearing*—In four cases there was impairment or total loss of hearing of the nerve type on the corresponding side.

G. M. had partial impairment of hearing of the nerve type on the right side. A test of the vestibular status indicated that there was spontaneous nystagmus to the right and left, more pronounced to the left, and vertical nystagmus upward. There was no spontaneous past-pointing. Caloric tests showed the right vertical canals to be normal after five minutes. The horizontal canal on the right gave a positive reaction. There was no vertigo or past-pointing. The vertical and horizontal canals on the left gave a positive reaction. At operation a cerebellar tumor was found springing from the inferior portion of the vermis and growing to the right, which could not be removed. The otologist had made a diagnosis of cerebellar neoplasm on the right side with pressure on the eighth nerve on the right.

A. C. had total loss of hearing and of vestibular function on the right side. We considered the lesion to be a neoplasm of the angle. The neurologist diagnosed a cerebellar lesion with involvement of the pons. Operation disclosed a cerebellar cyst on the right.

M. C. had almost total loss of hearing on the right side. The vestibular test caused no response in the vertical canals on the right. The horizontal canal on the right side gave a normal response, and the canals on the left were normal. The otologist's impression of a cerebellar lesion with neighboring phenomena

affecting the eighth nerve was confirmed at operation. A neurologist did not examine this patient.

A. F. had marked impairment of hearing of the nerve type on the left side. The vestibular test showed spontaneous nystagmus in all directions, chiefly to the left. There was past-pointing with both arms outward. The caloric test did not elicit nystagmus, vertigo or past-pointing in either canal. The otologist diagnosed

TABLE 1—*Spontaneous Nystagmus and Past-Pointing in Fourteen of Twenty-Two Cases of Cerebellar Lesions*

Patient	Direction	Direction of More Marked Nystagmus	Past-Pointing	Otologic Impression	Neurologic Diagnosis	Diagnosis at Operation or Autopsy
G. M.	R and L, vertical, up	L	None	R cerebellar lesion, interference with function of 8th nerve	R cerebellar and vermal lesion	Inferior vermis growing to the right
S. W.	R and L	L	None	Bilateral cerebellar lesion	R cerebellar lesion	R cerebellar lesion
B. G.	R and L, vertical, up and down	L	Not noted	Lesion in posterior fossa, midline cerebellar lesion	R cerebellar lesion	R cerebellar lesion
I. H.	R and L	L	None	R cerebellar lesion	L cerebellar lesion	L cerebellar lesion
M. Me.	L and R	L	Not noted	R cerebellar lesion	R cerebellar lesion	Verified
A. F.	All directions	L	Both arms outward	R cerebellar lesion with pressure on brain stem	L cerebellar lesion	R cerebellar lesion
S. F.	To L	To L only	None	L cerebellar lesion	L cerebellar lesion	Verified
M. D.	To L	To L only	Not noted	L cerebellar lesion	L cerebellar lesion	Verified
M. C.	R and L, oblique, up and to L	R	Not noted	R cerebellar lesion with involvement of 8th nerve	R cerebellar lesion	Verified
B. K.	R and L, vertical, up and down	R	Not noted	L cerebellar lesion	L cerebellar lesion	Verified
R. O.	R and L	R	None	L cerebellar lesion	Lesion in posterior fossa, no further localization	L cerebellar lesion
I. F.	R and L, vertical	Not mentioned	None	Lesion in posterior fossa	R cerebellar (?) lesion	R cerebellar lesion
A. C.	R and L, vertical, up	Not mentioned	None	R cerebellar lesion with phenomena referable to brain stem	R cerebellar lesion with pontile involvement	Verified
O. N.	R and L, vertical, up	Not mentioned	Inward, each arm	L cerebellar lesion with phenomena referable to brain stem	L cerebellar lesion	Verified

the condition as a neoplasm of the left side of the cerebellum with pressure on the brain stem. The neurologist did not consider this condition to be a neoplasm. The findings at operation coincided with the findings of the otologist.

*Caloric Tests*—The characteristic findings on caloric stimulation in a patient with a lesion of the posterior fossa with localization in the cerebellum are (1) diminution or absence of vertigo, (2) diminution or absence of past-pointing or past-pointing in the wrong direction,

TABLE 2—*Resume of the Comparative Diagnoses, Otologic and Neurologic, with Operative or Postmortem Observations in Eleven of Twenty-Two Cases of Cerebellar Lesion in Which There Was Not Diagnostic Agreement on Localization*

Patient	Otologic Finding	Otologic Impression	Neurologic Impression	Diagnosis at Operation or Autopsy	Reason for Difference or Error in Diagnosis
Disagreement 4 Cases					
M R	Normal	Normal	R cerebellar neoplasm	Autopsy, glioma of R cerebellum	Age 41 years, poor cooperation
A C	R and L spontaneous nystagmus, vertical up, no past pointing Caloric test, R vertical and horizontal canals, no change from spontaneous reactions, no vertigo or past pointing L horizontal and vertical canals normal Hearing, total deafness on R	Complete lesion of R 8th nerve with phenomena referable to brain stem	R cerebellar lesion with involvement of pons	Operation, R gliomatous cyst in cerebellum	Vertical nystagmus upward, otologic findings justified diagnosis of total loss of function of R 8th nerve
J L	Normal	Normal	Neoplasm in I posterior fossa	Autopsy, fusiform glioma in cerebellum, no neoplasm	Error cannot be explained fairly, good cooperation on part of patient, normal findings on two examinations
A F	Partial impairment of hearing of nerve type, spontaneous nystagmus in all directions, more marked to L, past pointing with both arms outward Caloric test, no reactions, nystagmus, vertigo or past pointing in either ear	R cerebellar lesion with pressure on brain stem, or multiple sclerosis	Neoplasm, not diagnosed	R cerebellar neoplasm	Otologic findings at operation coincided as to side (R)
Partial Agreement 2 Cases					
R O	R and L fine, spontaneous nystagmus, more marked to R, no spontaneous past pointing Caloric test, R canals, normal nystagmus, past pointing, vertigo, L canals, normal nystagmus, no past pointing or vertigo Normal hearing	Lesion of L cerebellar hemisphere	Tumor in posterior fossa, no further localization	Operation, glioma in L cerebellar hemisphere	Verified
I F	Normal hearing, spontaneous nystagmus to R and L, vertical, up, no spontaneous past pointing Caloric test, R and L canals prompt nystagmus, past pointing could not be tested, no vertigo	Marked diminution of vertigo, suggesting considerable intracranial pressure in posterior fossa	Neoplasm in posterior fossa, R cerebellar neoplasm?	R cerebellar neoplasm	Impossible to test past pointing, partial localization

	Incomplete Examination 2 Cases		
		R cerebellar neoplasm	Operation R cerebellar neoplasm
		Peripheral portion of 8th nerve not involved, lesion located near mid line (posterior fossa)	Poor cooperation, vertical canals could not be tested
B G	Hearing was present but could not be tested, vertical canals could not be tested		
		Increased intracranial pressure, lesion could not be localized because of restricted examination	Incomplete examination
A S	Hearing normal on R, partially defective on L suggesting involvement of nerve type Caloric test total loss of caloric response with patient lying down	R cerebellar neoplasm	Operation large extracerebellar neoplasm
		Difference as to Side of Localization 2 Cases	
		R cerebellar neoplasm with neighboring phenomena influencing brain stem	Operation L cerebellar neoplasm
I H	Normal hearing, vertical nystagmus, R, L and up, no spontaneous past pointing Caloric test R horizontal and vertical canals, no past pointing with R arm, normal with L arm, L horizontal and vertical canals, normal past pointing, very little vertigo	L cerebellar neoplasm	R horizontal and vertical canals, no past pointing with R arm, normal with L
		Bilateral lesion of posterior fossa cerebellar lesion with involvement of brain stem	Operation L cerebellar neoplasm
II G	Normal hearing, spontaneous horizontal nystagmus, R, L, vertical and obliquely upward Caloric test no past pointing with R arm, irregular with L arm (inward outward), vertical canals, abnormal past pointing (spontaneous and induced) with abnormal nystagmus		Bilateral changes in past pointing on stimulation of either set of canals
		Otologic Findings Verified—Not Examined by Neurologist	1 Case
		R cerebellar lesion with neighboring phenomena affecting function of 8th nerve	Operation R cerebellar neoplasm
MI C	Hearing almost totally absent on R, normal on left Spontaneous nystagmus coarse to L, finer to R, oblique, upward and to L Caloric test R vertical canals, no responses as to nystagmus or past pointing, R horizontal canal, normal responses as to nystagmus and past pointing, no vertigo, L canals normal	Not examined by neurologist	Verified

(3) normal nystagmus unless pressure on the brain stem causes deviations from the normal, such as spontaneous vertical or oblique nystagmus or perverted nystagmus on stimulation, and (4) normal hearing. Occasionally, owing to pressure on the eighth nerve of a cerebellar neoplasm, there may be present impairment of hearing of the nerve type. Spontaneous past-pointing in one direction or, in the absence of spontaneous past-pointing, an inability to produce reactive past-pointing is suggestive of a lesion in the cerebellum. On the other hand, when normal past-pointing of each arm in either direction can be produced, it is probable that the cerebellum is intact. As in all methods of diagnosis, there are exceptions to this rule, but in general the foregoing observation holds true.

#### EXTRACEREBELLAR LESIONS OF THE PONTILE ANGLE AND PONS

There were eighteen cases in this group, including one of neoplasm in the pons. There were an equal number of men and women. Their ages varied between 23 and 71 years. The duration of illness before admission varied between eight months and fifteen years.

The most common symptom in this group was loss of hearing, this occurred in sixteen of the seventeen patients with tumor in the angle, and in fourteen of these it was the earliest complaint, in two others loss of hearing was preceded by tinnitus. In two, headache was the first symptom noted. In addition to deafness, nine patients had a complaint of vertigo, headache and dimness of vision, three had attacks of transient blindness. Eleven patients had a complaint of disturbance of gait, weakness or clumsiness, and two, of disturbance in speech and difficulty in swallowing.

When the growth is fully developed, the diagnosis of a neoplasm in the angle, from the vestibular cochlear findings, presents little difficulty. In the earlier stages, the presence of tinnitus and partial impairment of hearing of the nerve type with vertigo not uncommonly lead to a diagnosis of Ménière's disease. With further changes in the cochlear nerve and especially with diminution, and later loss, of vestibular function, the diagnosis becomes apparent.

Since a large percentage of all tumors of the brain are tumors of the cerebellopontile angle, a method that is so helpful in either localizing them or excluding them from this region immediately becomes of utmost importance. While it is true that the neurologist can diagnose lesions of the angle without a vestibular examination, it is equally true that general clinical phenomena must appear before such a diagnosis can be made. Gordon<sup>6</sup> cited instances of an unusual paucity of symp-

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<sup>6</sup> Gordon, Alfred. Unusual Paucity of Symptoms of Cases of Pontocerebellar Tumors, *Arch Int Med* 30 606 (Nov) 1922.

toms and signs in cases of tumor of the pontile angle. On the other hand, with a vestibular examination a diagnosis can be made rather early, at a time when surgical intervention promises the best results. The number of conditions that could simulate a typical vestibular symptom complex of the cerebellopontile angle are few, so that the vestibular tests furnish a definite means of determining the presence or absence of such a lesion. The following phenomena are usually regarded as characteristic in cases of tumor of the angle: (1) on the side of the tumor, loss or impairment of auditory and vestibular function, and (2) on the opposite side, normal auditory function and normal responses from the horizontal canal but absence of responses for the vertical canals.

In brief, otologic examination reveals a loss of function on both sides except in the cochlea and horizontal canal of the ear on the side opposite the tumor. In none of the five cases in which changes were noted on stimulation of the opposite canals was this change observed. On other occasions we have been able to demonstrate this finding. When such a combination of both peripheral and central phenomena exists in the same patient, the lesion is naturally located in the cerebellopontile angle. A tumor in this situation destroys the eighth nerve and produces a typical picture of a peripheral lesion on that side and, in addition, pressure phenomena which manifest themselves by various signs of a central lesion on a test of the opposite canals.

The presence of a peripheral lesion in this symptom complex is not difficult to determine, as the patient usually has a total loss of function of the eighth nerve in both branches, or, if the hearing is partially retained, the responses from the horizontal and vertical canals on that side are completely absent, making the evidence of a peripheral lesion on that side fairly clear. It is the element of a central lesion that requires the greatest interpretive skill. None of our patients showed typical reactions on stimulation of the opposite canals. There may be variations, as in five of our cases, from this characteristic reaction, making the interpretation far more difficult. For instance, the patient's hearing on the unaffected side may not be normal, owing to a long-standing catarrhal or suppurative process or perhaps to an old preexisting degeneration of the eighth nerve or cochlear nerve. Again, the horizontal canal on that side may respond but in such a manner as to make it difficult to determine that the response is perhaps not impaired as compared to that of the fully normal canal. In cases of this type other phenomena are often exhibited which are indicative of a central lesion, such as vertical nystagmus, up or down or perverted nystagmus on the unaffected side or a definite disproportion between ocular responses and vertigo. In one of our cases perverted nystagmus was present on



TABLE 3—*Spontaneous Nystagmus and Past-Pointing in Cases of Tumor of the Pontile Angle*

Patient	Direction	More Marked Direction	Past Pointing	Otologic Impression, Involvement of	Neurologic Diagnosis	Operation or Autopsy
R K	R and I, vertical, up	Not mentioned	None	Peripheral portion of L 8th nerve	Neoplasm L pontile angle	Operation
J M	R and I vertical, up	Not mentioned	None	Peripheral portion of L 8th nerve	Neoplasm L pontile angle	Operation
J T	R and L	Not mentioned	None	Peripheral portion of R 8th nerve	Neoplasm R pontile angle	Operation and autopsy
I S	R and I	Not mentioned	None	Peripheral portion of L 8th nerve	Neoplasm L pontile angle	Operation
S B	R and L	Not mentioned	None	Peripheral portion of R 8th nerve	Neoplasm R pontile angle	Operation
A S	R and L, vertical, up	Not mentioned	Not mentioned	Peripheral portion of 8th nerve bilateral marked	Neoplasm pontile angle bilateral	Operation
E R	None		None	Peripheral portion of L 8th nerve very little function	Neoplasm L pontile angle	Autopsy
F S	R and L vertical up	L	With both arms to L	Peripheral portion of R 8th nerve	Neoplasm, R pontile angle	Operation
A L	R and L vertical up	Not mentioned	With both arms to L	Peripheral portion of 8th nerve, total, bilateral	Neoplasm pontile angle bilateral	Operation
L S	R		None	Peripheral portion of R 8th nerve	Pontile neoplasm	Operation and autopsy
M S	R and L	Not mentioned	None	Peripheral portion of L 8th nerve	Neoplasm, I pontile angle	Operation
J K	R and L	R	Inward with L arm	Peripheral portion of R 8th nerve	Neoplasm R pontile angle	Operation
J D	R and L	R	Spontaneous, direction not mentioned	Peripheral portion of R 8th nerve	Neoplasm R pontile angle	Operation
A N	None		None	Peripheral portion of R 8th nerve	Neoplasm R pontile angle	Operation
M R	R and L	L	None	Peripheral portion of L 8th nerve	Neoplasm L pontile angle	Operation
F K	R and L	L	To L with both arms in prone position only	Peripheral portion of L 8th nerve	Neoplasm, L pontile angle	Operation
H C	R and L vertical and oblique up	R	None	Peripheral portion of L 8th nerve	Neoplasm L pontile angle	Operation
L Se	R and L	Not mentioned	Not mentioned	Peripheral portion of R 8th nerve	Neoplasm R pontile angle	Operation and autopsy

stimulation of the opposite horizontal canal, i. e., vertical nystagmus upward and downward following such stimulation. In three cases there was interference or wrong past-pointing with either hand on stimulation of the opposite canals. In twelve of the cases of tumor in the angle there was a normal response on stimulation of the opposite vertical canals. Careful observation in such instances makes it possible sometimes to detect a definite difference between the activity of the horizontal and that of the vertical canals.

TABLE 4—*Induced Reactions Nystagmus and Past-Pointing in Cases of Tumor of the Pontile Angle*

Patients		Left Canals	Right Canals
R K *	No response		Positive reactions no past pointing with L arm
J M	No response		Normal
J F	Normal		No response
J S *	No response		Vertical canals normal, no vertigo, horizontal canal perverted, nystagmus oblique, upward and to L, very little vertigo
S B	Normal		Very weak, delayed responses
A S	Bilateral total loss of hearing, very little or no response R and L, inward past pointing on stimulation of each set of canals		
E R	Faint response for nystagmus, no past pointing or vertigo		Normal
F S	Normal		No response
A Y	Normal nystagmus, inward past-pointing with each arm		No response, inward past pointing with each arm
L S	Normal		No response
M S	No response		Normal
J K *	Spontaneous past pointing inward, L arm not influenced		No response, hearing of R showed partial defect of nerve
J D	Normal		No response
A N	Normal		No response
M R *	No response		Normal nystagmus and vertigo, past pointing with L arm but not with R
F K	No response		Normal
H C	No response		Normal
L Se	Normal		No response

\* An abnormal condition was noted in the canals opposite to the site of the lesion

The isolated loss or marked diminution of responses from the vertical canals on the opposite side, the occurrence of perverted nystagmus on stimulation of the opposite horizontal canal and abnormalities of past-pointing appear to be caused by pressure of a tumor on the pons. In a case of a well advanced growth in the angle, abnormalities in past-pointing are frequently observed either in the form of spontaneous past-pointing or as absence or impairment of past-pointing after stimulation of the ear. Crossed past-pointing, in which both arms past-point

inward or outward, was not observed in our cases but has been noted on other occasions

*Nystagmus*—The incidence of spontaneous nystagmus in the cases of tumor of the pons and pontile angle was as follows

	Number of Cases	Direction of Nystagmus	Number of Cases
Lesion on R	7	Not mentioned	3
		More marked to R	2
		More marked to L	1
		No nystagmus	1
Lesion on L	5	Not mentioned	4
		More marked to L	2
		More marked to R	1
		No nystagmus	1
Bilateral lesion	2	Not mentioned	2
Pontile lesion	1	To R only	1

Of the fifteen cases of tumor of the pontile angle localized to the right or the left, nystagmus was directed to the side of the lesion in four and to the opposite side in two, and the direction was not mentioned in seven. There was no nystagmus in two. Spontaneous vertical nystagmus was present in six cases.

*Spontaneous Past-Pointing*—This was not present in eleven cases and was not mentioned in two. In the five cases in which it was noted the distribution was as follows

Lesion on R	(3 cases)	1 case	both arms to L
		1 case	L arm inward
		1 case	direction not noted
Lesion on L	(2 cases)	1 case	both arms to L (prone position)
		1 case	past pointing, direction not noted
Bilateral lesion	(1 case)	Both arms to L	

In the five cases in which spontaneous past-pointing was present, localization was not helped by this finding.

*Hearing*—There was total loss of hearing in sixteen cases, in nine on the left side, and in seven on the right. Hearing was present in two cases. In one there was marked impairment of hearing, although vestibular function was present, and in the other the hearing was moderately impaired, with total loss of vestibular function. The neoplasm was found on the side corresponding to the loss of hearing.

*Caloric Tests*—Changes in opposite canals on stimulation occurred as follows in four cases of tumor in the angle

Patient	Side of Lesion	Observations
J K	R	Spontaneous past pointing inward with L arm not influenced by stimulation of L canal
R K	L	Positive reaction. R arm past pointed to R, no past pointing with L arm
J S	L	Normal vertical canals, no vertigo, horizontal canal showed perverted nystagmus oblique, upward and to L, very little vertigo
M R	L	Past pointing with L arm but not with R

## COMMENT

Keschner and Grossman<sup>7</sup> made a comprehensive report on cerebellar symptomatology, with an evaluation on the basis of intracerebellar and extracerebellar lesions. From a study of table 5 it is evident that the disturbance in synergic movement occurred more constantly in the cases of cerebellar lesion. The degree of involvement was also greater, as indicated by an analysis of the signs of cerebellar involvement. These were usually more marked on the side of the lesion. They may there-

TABLE 5—*Neurologic Signs and Symptoms in Twenty-Two Cases of Cerebellar Lesions and Eighteen Cases of Tumor of the Pontile Angle*

Symptoms		Number of Cases	
		Cerebellar (22)	Pontile Angle (18)
Direct	Asynergia	Gait	9
		Station	10
		Attitude of head	10
		Ataxia of arm	9
		Ataxia of leg	4
		Adiadokokinesis	9
		Gordon Holmes sign	2
		Hypotonia	4
	Vestibular	Spontaneous nystagmus	16
		Spontaneous past pointing	5
Indirect	Cranial nerves	1	14
		2	7
		3, 4, 6	7
		5, sensory and motor	7
		5, sensory	2
		Corneal sensibility	4
		Peripheral facial	4
		8	17
		9, 10, 11, 12	4
		Signs referable to pyramidal tract	11
Subjective		Headache	13
		Vomiting	3
		Vertigo	12
		Diplopia	1
		Clumsiness of gait	9
		Diminished vision	9
		Deafness	16 (2 partial)
		Tinnitus	6
		Paresthesia of face	5
		Disturbance of sphincters	1
		Mental disturbances	4

fore be used as a factor in distinguishing lesions within the cerebellum as well as in localizing the side on which the lesion exists. In the cases of cerebellopontile involvement the signs of asynergia were less marked and occurred in a proportionally fewer number of cases, nevertheless they indicated the side on which the lesion existed. The almost constant involvement of the eighth nerve on the side of the lesion is a more reliable guide to localization in the cases of cerebellopontile involvement. As a rule, the general symptoms of tumor of the brain appear earlier

<sup>7</sup> Keschner, Moses, and Grossman, Morris. Cerebellar Symptomatology. Evaluation on the Basis of Intracerebellar and Extracerebellar Lesions, Arch Neurol & Psychiat 19 78 (Jan) 1928

TABLE 6—*Observations on Freely-Free Verified Cases of Cerebellar Lesion*

Vestibular Status										
Patient	Auditory Status	Hearing	Spontaneous Nystagmus	Past Pointing	Induced Nystagmus		Otologic Impression	Neurologic Impression	Operation or Autopsy	Verification and Reason for Difference or Error in Diagnosis
					Caloric Tests					
N R	Normal	Normal	None	None	R vertical canals faint nystagmus in 2 min, normal past pointing R horizontal canal marked nystagmus, vertigo marked, R arm, no past pointing L vertical canals positive in 1 min, past pointing with L arm, R arm touched L horizontal canal no nystagmus or vertigo, past pointing with L arm, R arm touched R canals positive L canals positive	Interference with all past pointing with R arm except that following stimulation of R vertical canals, suggesting extensive lesion in R internal lobe of cerebellum	R cerebellar neoplasm	Operation R cerebellar cyst	Verified	
M R	Normal	Normal	None	None	R prompt nystagmus, impossible to test past pointing, very little vertigo L prompt nystagmus	Norm il		R cerebellar neoplasm	Autopsy R cerebellar glioma	All 1½ years, poor cooperation
I F	Normal	Normal	R and L, vertical, up, no vertigo	None	R prompt nystagmus, impossible to test past pointing, very little vertigo L prompt nystagmus	Marked diminution of vertigo, suggesting considerable intracranial pressure in posterior fossa		Neoplasm in posterior fossa, R cerebellar neoplasm?	R cerebellar neoplasm	Impossible to test past pointing, partial focalization
G M	Normal	Partial involvement of nerve on R	R and L, more marked to L, vertical, up	None	R vertical canals negative after 5 min R horizontal canal positive, no vertigo or past pointing L vertical and horizontal canals positive	Increased intracranial pressure on R side (cerebellum) with interference of R 8th nerve		Neoplasm of vermis and right cerebellar lobe	Cerebellar tumor from inferior vermis growing to R, could not be removed	Verified
A C	Normal	Total deafness on R	R and L vertical, up	None	R vertical and horizontal canals no change from spontaneous reactions, no vertigo or past pointing L vertical and horizontal canals normal	Complete lesion of R 8th nerve with phenomena referable to brain stem		R cerebellar neoplasm with involvement of pons	Operation R gliomatous cyst in cerebellum	Vertical nystagmus, up, otologic findings justified diagnosis of total loss of function of R 8th nerve
B K	Normal	Normal	R and L, slow to L, vertical, down and up		L vertical canals negative after 4 min, no nystagmus, past pointing or vertigo L horizontal canal nystagmus to R, spontaneous nystagmus persisting in all directions R vertical canals faint nystagmus, no vertigo R horizontal canals nystagmus to R, with pallor and sweating, slight past pointing with R arm to R	(1) Marked diminution of vertigo with absence of or diminution of past pointing, entire cerebellum, chiefly L side involved, (2) lesion affecting posterior longitudinal bundle with perhaps more involvement on L side	L cerebellar neoplasm	L cerebellar neoplasm	Verified	



TABLE 6—*Observations on Twenty-Two Verified Cases of Cerebellar Lesion—Continued*

Patient	Auditory Status	Hearing	Vestibular Status				Otolgic Impression	Neurologic Impression	Operation or Autopsy	Verification and Reason for Difference or Error in Diagnosis
			Spontaneous Nystagmus	Past Pointing	Induced Nystagmus Caloric Tests					
O N	Normal	Normal but persistently lateralized to L. no other signs of defect in hearing	Inward, both hands	R horizontal and vertical canals normal nystagmus and past pointing L horizontal and vertical canals normal responses as to nystagmus, no change in spontaneous past pointing, i.e., inward past pointing unaffected no vertigo, nausea or vomiting	Absence of past pointing on stimulation of horizontal and vertical canals (nystagmus normal), indicating interference with cerebellocerebral pathways, lesion probably in L cerebellar hemisphere vertical nystagmus pointing to pressure on brain stem	Neoplasm in vermis and I cerebellum	Autopsy L cerebellar neoplasm	Verified		
I A	Normal	Normal		L vertical and horizontal canals nystagmus and vertigo but no past pointing R canals normal responses	Lesion of L posterior fossa (horn)	L cerebellar lesion involving brain stem	Autopsy lesion in L cerebellum, vermis and brain stem	Verified		
R A	Normal	Normal	None	L vertical canals delayed nystagmus past pointing, normal, no vertigo or vomiting R vertical and horizontal canals no past pointing with L hand	R cerebellar lesion	Cerebellar neoplasm?	Autopsy bilateral tuberculous of cerebellum (R side more markedly involved than L)	Verified		
E C	Normal	Unsatisfactory test apparently no lesion of cochlea	Inward with I hand	I horizontal and vertical canals prompt nystagmus, normal past pointing on stimulation of L vertical canals, no past pointing with L hand on stimulation of L horizontal canal R vertical canals no vertigo or nystagmus R horizontal canal no nystagmus Past pointing not influenced by stimulation of R vertical and horizontal canals, i.e., patient touched with R hand, spontaneous past pointing with L hand not influenced	(1) Normal cochlear function (2) No function of vertical canals inward with L hand (3) Spontaneous past pointing (4) No reaction for past pointing in canals on R side Impression spontaneous past pointing and absence of induced past pointing, on R suggesting R cerebellar neoplasm	R cerebellar neoplasm	Operation R cerebellar neoplasm	Verified		

			Total loss of reaction; patient lying down		Incomplete examination		Incomplete examination	
A S	Normal	Partial involvement of L nerve, normal on R						
M Me	Normal	R and L <sub>1</sub> more marked to L <sub>2</sub> , no vertigo	R horizontal and vertical canals normal response for nystagmus, vertigo diminished, past pointing perverted so that both arms past pointed to R instead of to L, no lesion in either eighth nerve		Incomplete examination, findings indicate increased intracranial pressure, lesion not localized because of restricted examination	R cerebellum, neoplasm	Operation eye, the glioma in R cerebellum lobe, aspirated	Verified
A P	Normal	Woken to L, R C shorted to L <sub>1</sub> , high tones markedly reduced, noise apparent, hears L, normal hearing R	Outward, both arms	No reactions, nystagmus, vertigo or past pointing in any canal		Neoplasm (not localized)	R cerebellum neoplasm	Otolopie and operative findings (collected as to side (R)
M D	Normal	L <sub>1</sub> more marked with patient prone		R canals normal nystagmus and past pointing L canals no vertigo no past pointing with L hand and proper past pointing with R hand (same for L horizontal canal), normal nystagmus both sets of canals	Interference with vertigo on L, indifference on L, cerebellum lesion	L cerebellum, neoplasm, L cerebellum eye	L cerebellum eye	Verified
U G	Normal			R and L horizontal and vertical canals prompt nystagmus, some what oblique on stimulation of horizontal canal R horizontal and vertical canals no past pointing L horizontal and vertical canals abnormal past pointing, 10°, occasional forward past pointing with L hand	Spontaneous horizontal nystagmus R and L, and vertical and oblique upward, no past pointing with R hand, L hand irregular (inward or outward), abnormal past pointing (spontaneous and induced) with abnormal nystagmus (vertical) pointing to bilateral lesion in posterior fossa cerebellum lesion with involvement of brain stem	L cerebellum neoplasm	Operation L cerebellum eye	Proton caused by bilateral changes in past pointing on stimulation of either set of canals



and are more pronounced in the cases of cerebellar involvement. The cranial nerves are less impaired. The early onset and greater intensity of the cerebellar symptoms, especially of disturbance in gait and ataxia, are in favor of a diagnosis of intracerebellar lesion. The presence of signs of cerebellar involvement on one side, with involvement of the pyramidal tracts on the opposite side, is more in favor of a diagnosis of a lesion outside the cerebellum compressing the pons. Tinnitus and deafness, associated with involvement of the trigeminal and of the facial nerve on the same side, are early and almost constant symptoms in cases of lesion in the cerebellopontile angle.

#### CONCLUSIONS

1 Caloric tests are of definite value in the localization of a lesion of the posterior fossa.

2 The differential diagnosis of an infratentorial from a supratentorial lesion can frequently be made.

3 Cerebellar neoplasms which have invaded the surface of the cerebellum, because of pressure phenomena affecting the eighth nerve, may give signs of a neoplasm of the angle on otologic examination.

4 Caloric tests are of distinct value in the early diagnosis of a lesion of the cerebellopontile angle.

5 The so-called characteristic finding in a case of neoplasm of the angle, namely, loss of reaction on testing of the opposite vertical canals, is frequently lacking. Other evidence of indirect pressure phenomena may be present on vestibular examination.

6 A comparative diagnostic study by means of otologic, neurologic, surgical and postmortem observations on forty cases of lesions of the posterior fossa has been made.

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#### ABSTRACT OF DISCUSSION

DR ISIDORE FRIESNER, New York. Some work which has developed this past year at the Neurological Institute of New York is remarkable. I believe that otologists have been rather slow in making observations on the eighth nerve. The work of the ophthalmologists antedates that of the otologists by many years. Recent neurologic work deals with the sense of smell. These tests, which are fine and accurate, show amazing results. There are two elements in the sense of smell: the trifacial element and the olfactory element. Patients from the general neurologic service were sent for these olfactory tests. The persons making the tests were not informed of the diagnosis in any case. I am told that it was possible to determine the side on which there was a disturbance of the trifacial element and whether there was a tumor of the posterior fossa or one of the angle and also the side on which the tumor was located. That had been done repeatedly and correctly. There is no question in my mind that the subject should be pursued in all hospitals where there is a neurologic service. Otologists should continue to carry out functional tests of the eighth nerve in all neurologic conditions.

# VALUE OF SPEECH TRAINING IN CASES OF CLEFT PALATE AND OTHER ORAL CONDITIONS

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The quality of the patient's speech is the best criterion of the success of treatment of cleft palate. To obtain perfect speech in the majority of cases one has to correct not only the escape of air nasally but also defects of articulation. The soft palate is part of a muscular mechanism the function of which is to separate the oral cavity from the nasopharyngeal cavity during swallowing and during speech. This closure must be complete for correct articulation of every sound in the English language except the three nasal consonants M, N and NG. For the articulation of these consonants the air escapes through the nose, and the resonance is essentially nasal. It is apparent, therefore, that the palatopharyngeal sphincter not only must be capable of perfect closure but must also be capable of very rapid movement.

## REQUIREMENTS FOR SUCCESS IN TREATMENT OF CLEFT PALATE

The following requirements are necessary for successful results in the treatment of cleft palate. 1. There must be competent palatopharyngeal sphincter. This may be accomplished by (a) operation, the use of an artificial appliance or a combination of the two and by (b) exercises to improve the action of the palatopharyngeal sphincter. In other words, the patient not only must be given a good palate but must be taught to use it. Wardill aptly said "The first essential is to make the child valve-conscious." The child must first be taught that the air must pass through the mouth during speech. This is best accomplished by simple exercises, such as blowing out the cheeks, blowing through the mouth as if blowing out a candle, blowing bubbles, etc. Toy balloons are popular with children and can be used to advantage. For older children whistling is a very good exercise. Palatal movement can often be improved by touching the soft palate with a tongue depressor while the patient phonates AH. Electrical stimulation of the muscles of the palate can be used on older children, but it is rather difficult to use and frightens the younger patients. My associates and I have not found it very useful. The simplest and best method is to have the patient watch his own palate in a mirror. The mirror should be sufficiently large

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From the Clinic for Speech Training, Children's Memorial Hospital

Read before the Section on Laryngology, Otology and Rhinology at the Eighty-Sixth Annual Session of the American Medical Association, Atlantic City, N J, June 14, 1935

so that he can also watch the movements of the instructor's palate. In this way he can visualize what is required, and the element of competition is also useful. Breathing exercises and tongue exercises should also be started at this stage to prepare the child for future training in articulation.

2 The degree of intelligence is a very important factor in the development of speech in any child. Judging from the study of the intelligence quotients of our patients, mental deficiency of varying degree is fairly common in patients with cleft palate. It is also noticeable that defects of articulation are more frequent and also more difficult to correct in the patient with a low intelligence quotient.

3 Ambition, discipline and cooperation are important factors in obtaining successful results.

4 The acuity of hearing also has a bearing on the problem. To learn to speak properly the child must be able to hear the sounds correctly. The presence of a cleft palate makes a patient more susceptible to catarrh of the eustachian tube and suppurative otitis media, with resultant defects in hearing, at an age at which acuity of hearing is most important.

5 Special training is necessary. This involves the previously mentioned exercises and also the correction of defects of articulation. Intelligent cooperation of parents and teachers is an absolute essential. Speech training in a clinic once or twice weekly is almost useless unless a similar amount of time is spent each day at home, and considerable of the time in the clinic is spent in instructing the parents how to train the child at home.

#### CLEFT PALATE SPEECH

Patients with cleft palate may be divided into five main groups according to the characteristics of their speech.

- Group 1 Escape of air nasally and failure to articulate consonants (except M N and NG)
- Group 2 Escape of air nasally and defects of articulation
  - (a) Omission of some consonants
  - (b) Incorrect articulation of some consonants
  - (c) Substitutions (T and D for K and G, W for R, etc.)
  - (d) Compensatory speech habits
    - Glottal stop
    - Pharyngeal and nasal S
    - Constriction of nares, etc.
- Group 3 Only escape of air through nose
- Group 4 Defects of articulation only (no escape of air nasally)
  - (a) Omission of some consonants
  - (b) Incorrect articulation of some consonants
  - (c) Substitutions (T and D for K and G, W for R, etc.)
  - (d) Compensatory speech habits
- Group 5 Normal speech

The defect presented by the patients in group 1 is, of course, the worst. There is an escape of air through the nose when the patient makes all sounds, and he makes no attempt to articulate any except the nasal consonants. His speech is not understandable, except possibly to his parents. The intelligence quotient of such a patient is low, and hearing may also be impaired. One should not consider these children as hopeless, however, as we have two patients with speech defects of this type who acquired understandable speech in two years. The prognosis depends largely on the degree of intelligence, the cooperation of the child and the parent and the acuity of hearing.

The patients in group 2 make up probably the largest group in the average clinic. There is escape of air nasally when some or all of the sounds are made and various types of defects of articulation. The intelligence of the patients is much superior to that of the patients in group 1, in fact, many of the children are very bright. The defects of articulation are of four main types: (a) omission of some consonants, (b) incorrect articulation of some consonants, (c) substitutions and (d) compensatory speech habits. The first three types are not necessarily typical of cleft palate speech. They are the types of defects of articulation which may be found in any child and are rather a persistence of baby talk. However, most patients with cleft palate show these defects to some extent. If the patient is intelligent and cooperative, the defect is usually quite easy to correct.

In the fourth type of compensatory speech habits there are the typical defects of articulation which arise from a cleft palate. The child is usually moderately intelligent and endeavors by various means to overcome the difficulties in speech caused by the cleft palate. He first attempts to articulate the plosive consonants, P, B, T, D, K and G, and finds that the air escapes through the nose, spoiling the plosive effect. He also finds that the only place he can get a complete closure is in the glottis, and this is the beginning of one of the most common compensatory speech habits in cases of cleft palate, namely, the glottal stop. This is made by bringing together the vocal cords, momentarily stopping the breath stream at this point, and then suddenly releasing it. This is nothing more than the ordinary grunt, and a fair imitation of the plosive consonants may be obtained in this way. The speech, however, is very unpleasant to listen to. The glottal stop may be substituted for any of the plosives, but it is most commonly used as a substitute for K and G. For P, B, T and D the child can usually learn the positions of the tongue and lip by imitation, and the glottal stop is not developed so often as a substitute for these consonants. The S sound is one of the most difficult for the patient with a cleft palate to acquire. In the first place, prolonged friction is necessary, and this is impossible without a closed palatopharyngeal sphincter. Secondly, it is very difficult to learn

the position of the tongue for this sound by imitation. The patients react to this in various ways. Those who are not very intelligent or are rather indifferent are quite satisfied simply to let the air escape through the nose and with or without the aid of "constriction of the nares" get a fricative sound. Of course, to the untrained ear of a very young child whose hearing is not well developed or who has some other auditory impairment there is possibly very little difference between the friction in the articulation of a correct S sound and the rush of air through the nose that constitutes a nasal S. Other patients, either owing to a higher grade of intelligence or owing to the fact that their hearing is more acute, are not satisfied with a nasal S and develop a pharyngeal S. I do not know exactly how they execute this, but the chief characteristic of it is that it can be made with the mouth open. The tongue is most probably drawn back close to the posterior pharyngeal wall, and the S sound is produced by a rush of air through this space. It is a much better sound than the nasal S but equally hard to correct. A few of the more intelligent patients learn the correct position of the tongue, and their S is a combination of a weak normal one supplemented by the escape of air nasally. Constriction of the nares is one of the first habits that these patients acquire and is an attempt to limit the escape of air through the nose. In this way they get a better plosive effect, but they also make the escape of air through the nose more audible.

These compensatory speech habits constitute the most difficult problems in speech training, as the old habits must be forgotten before new ones can be formed.

The defect shown by the patients in group 3 constitutes, as a rule, one of the stages in speech training, and the escape of air nasally still has to be corrected either by further training or by further operative work.

The patients in group 4 present defects similar to those of group 2, except that escape of air through the nose has been eliminated.

Normal speech (group 5) is the ultimate goal that all hope for but too rarely observe in treatment of cleft palate.

#### CORRECTION OF DEFECTS OF ARTICULATION

If the child has already begun to talk, the first essential is a thorough analysis of his speech before operation and again before commencing training. To do this one must know the proper positions of the organs of speech for the vowels and more especially for the consonants. The classification of consonants in table 1 should prove useful. This classification is twofold, representing (*a*) the organs of articulation, as bilabial, labiodental, etc., and (*b*) the manner of articulation, as plosive, fricative, etc.

Most consonants can be pronounced with or without simultaneous vibration of the vocal cords. If the vocal cords are not vibrating, voiceless consonants, such as P, T, K, F, TH, S and SH, are produced. When the vocal cords are vibrating, voiced consonants, such as B, D, G, V, TH (V), Z, SH (V) and L, are the result. Thus there are pairs of consonants similarly articulated in the mouth but differing in that one of each pair must be accompanied by vibration of the vocal cords, such pairs are P, B, T, D, K, G, F, V, S, Z, etc. There are also voiceless and voiced TH and SH. Thus TH in *thin* differs from TH in *then*. The SH sound in *pleasure* is the voiced equivalent of the SH in *she*.

It is very difficult by merely listening to a child's speech to tell which sounds are at fault, so it is necessary to test each consonant separately in simple words or syllables. Tests should be made with words in

TABLE 1—*Classification of Consonants* \*

	Bilabial	Labio dental	Dental	Alveolar	Palato alveolar	Palatal	Velar	Glottal
Plosive	P B			T D			K G	.
Nasal	M			N			NG	
Lateral				L				
Rolled				R				
Fricative		F V	TH TH (V)	S Z	SH SH (V)			H
Semivowel	W					Y		

\* TH, voiceless as in *thin*, TH (V), voiced as in *then*, SH, voiceless as in *she*, SH (V), voiced as in *pleasure*.

which the consonant occurs at the beginning, at the end and in the middle. It is quite usual to find patients who articulate a consonant at the beginning of a word or syllable but do not articulate it at the end. All the consonants should be tested and the defective ones corrected by appropriate means.

At first it may be necessary to hold the child's nose, or to get him to hold it himself, so that his ear may become trained to the correct sounds. Many of the sounds can be learned by imitation, and the speech trainer must have an accurate knowledge of the positions of the organs of speech for each sound.

Plosives are usually more easily learned than fricatives and should be taught first. It is best to begin with P, B, T and D, as the patient can see and imitate the positions of the organs of speech for these sounds. The voiceless consonants are as a rule more easily learned than the voiced. These general principles also apply to the fricatives and other consonants.

## TESTS FOR COMPETENCY OF THE PALATOPHARYNGEAL SPHINCTER

Contact between the soft palate and the posterior pharyngeal wall occurs at a level above the uvula, and it is difficult by inspection alone to determine if the palatopharyngeal sphincter is competent. It is also impossible to see whether it is functioning or not during the articulation of consonants, except possibly K and G. I have seen several patients in whom the soft palate apparently functioned perfectly on articulation of vowels but there was no attempt at movement on articulation of consonants. These patients apparently did not realize that they needed a closure of the palatopharyngeal sphincter except during the articulation of vowels. It is therefore useless to judge the efficiency of the sphincter by simply watching the soft palate while the patient phonates AH. Blowing out the cheeks is equally unreliable, as the patient soon learns to fill up any deficiencies with his tongue. Blowing up rubber balloons is a fairly reliable test, but it does not tell one whether or not the palate is being used for all sounds. The two most simple and reliable tests are (1) the snorting test and (2) the stethoscope test. The former, I think, was first described by Waidill, and I shall give you his description of it. "The patient is instructed to put the tongue slightly out and grip it between the lips. Air is then sucked into the nose as in the impolite act of clearing away pharyngeal mucus. A characteristic sound resembling the snore of a deep sleeper is produced and can be sustained and repeated if pharyngeal closure is attained. I think that the stethoscope test is more reliable for judging the amount of air that escapes nasally and for determining if this escape occurs with all sounds. A small glass tube is used to replace the bell or diaphragm of an ordinary stethoscope. This tube is held under the patient's nose while he is tested for all the vowels and consonants. It can also be used to advantage for an intelligent patient by letting him listen to the escape of air through his nose and comparing this with the absence of this defect in a normal person. The escape of air nasally is indicated by a harsh sound which is very apparent to the ear of the listener.

I shall try to give as briefly as possible the results of our work in the past three years. The accompanying chart shows the progress in eleven of our patients for whom sufficient data are available (e.g., intelligence quotient, etc.)

Patient 1 was first classified in group 1, i.e., there was an escape of air through the nose in the articulation of all sounds, and he did not articulate any of the consonants except M, N and NG. His intelligence quotient was 57.5. In two years he had advanced to group 4, i.e., there was no escape of air nasally but still some defects of articulation. The patient is still in group 4, but he can now articulate practically all sounds correctly in isolation. He still makes mistakes when he attempts sen-

tences, but his speech is fairly understandable. All the patients represented in the chart have shown improvement. Only one of the eleven (no. 17) has, in my opinion, acquired perfectly normal speech. This patient when first seen in 1932 was in group 2. She made some progress in the first year, but in 1933 she was still in group 2. In 1934 she made very rapid progress and reached group 4, and the following year her speech was normal. Six of the others have practically normal speech and are making good progress at school.

Table 2 gives in more detail the progress of seventeen of our patients who have attended the clinic fairly regularly. This table includes the data shown graphically in the chart.

All the patients except two, namely, patients 10 and 15, showed improvement. Patient 10 had an intelligence quotient of 75, but we

TABLE 2—*Progress of Seventeen Patients*

Case	Age	Group				Intelligence Quotient
		1932	1933	1934	1935	
1	4	1	2 bcd	4 bc	4 b	57.5
2	6	1	2 b	2 b	2 b	56.5
3	8		2 abcd	2 bd	2 bd	51.4
4	8	2 bd	2 bd	2 b	3	97.0
5	11	2 d	2 d	3	3	83.5
6	7	2 cd	2 d	3	3	102.0
7	6		2 bc	2 b	2 b	72.5
8	8	2 bc	2 b	4 b	4 b	70.0
9	11	2 cd	2 d	3	3	75.0
10	3	2 abcd	2 abcd		2 abcd	75.0
11	5		2 abd	2 d	4 d	
12	10			2 cd	2 d	
13	17			2 bc	2 c	
14	4			2 c	2 c	
15	3	1	1	1	1	
16	4	2 abcd	2 abd	2 b	2 b	
17	3	2 abcd	2 abd	4 b	5	80.0

did not get any cooperation from the parents and made no progress. Patient 15 was mentally deficient. In four patients in whom there was escape of air through the nose following operation competency of the palatopharyngeal sphincters developed as a result of speech training. Several others have no apparent escape of air nasally on speaking, but it can be detected by the stethoscope test. Five patients mastered all their defects of articulation, and it is interesting to note that they have an intelligence quotient of 75 or over. The age shown in table 2 is the age at which speech training was commenced. It is difficult to say at what age speech training shows the best results, as this varies considerably, depending on the intelligence of the patient. As a rule very little is accomplished before the age of 3, but I think that the patients should be kept under observation from the date of operation.

It is apparent that normal speech is very difficult to attain. So far I have seen only two patients whose speech was absolutely perfect.



However, although this goal is not reached very often, I think one can truthfully say that the speech of these children can be definitely improved by speech training

#### RECOMMENDATION

1 Unless a patient with a cleft palate is given a competent palatopharyngeal sphincter by operation before he learns to speak, he will

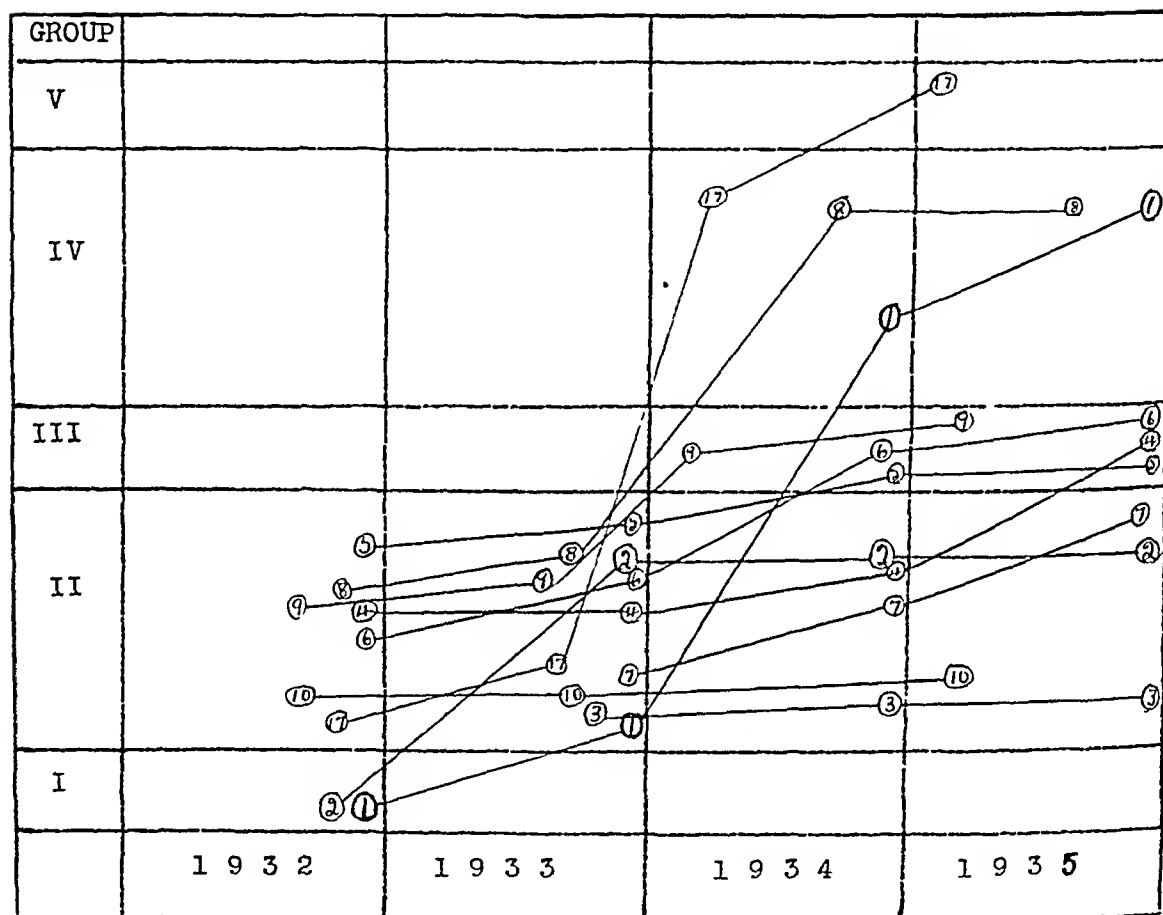


Chart showing the progress of patients with cleft palate in overcoming speech difficulties. Group I includes patients with escape of air nasally and inability to articulate consonants, group II, those with escape of air nasally and defects of articulation, group III, those with only escape of air nasally, group IV, those with only defects of articulation and no escape of air through the nose, and group V, those who have attained normal speech.

acquire defects of articulation, compensatory or otherwise. A competent palatopharyngeal sphincter should therefore be established, if at all possible, before speech habits are acquired. This does not mean that every child requires an operation at or before the age of 1 year. Many

children are backward and make no attempt to talk till much later than this, and the older the child, the less the chance that operation will prove fatal. One must therefore adjust the date of operation to suit the individual case.

2 The patient should have a complete analysis of his speech before operation if he has already begun to talk, and also before beginning any period of speech training.

3 The patient, if old enough, should begin postoperative speech training as soon as the palate is completely healed. If he is too young for training he should report at least once a month for observation. This gives the instructor an opportunity to advise the parents, and at the same time the child becomes accustomed to attending the clinic.

4 Observing the action of the palate by means of a mirror is the best method of improving the function of the palatopharyngeal sphincter.

5 If for any reason operation has to be postponed until after the child learns to talk, speech training should be started in the interval.

6 The period of training depends on the intelligence of the patient, but there should be a frequent check-up, as there is a tendency for such patients to return to their old habits. Two years of fairly constant observation is, I think, a minimum in most cases, and after that there should be a check-up every one or two months for an indefinite period.

7 Cooperation of parents and teachers is essential and is a very important factor in the ultimate success and in determining the duration of the period of training required.

#### SPEECH TRAINING FOR PATIENTS WITH OTHER ORAL CONDITIONS

Other oral conditions which are frequently of interest to the speech trainer are tongue-tie, enlarged tonsils and adenoids, irregular teeth and injuries to the soft palate.

Tongue-tie and enlarged tonsils and adenoids are, in my opinion, very much overrated as causes of defects of articulation. I have never seen a patient in whom a short frenulum was the cause of lisping (TH for S) or other defects. As a matter of fact, the tongue requires more freedom of movement for the articulation of TH than for S. I think, therefore, that the operation of cutting the frenulum linguae to improve speech should be discarded except in rare cases. Enlarged tonsils and adenoids can cause a typical speech characterized chiefly by lack of nasal resonance, but it is a mistake to advise patients to have the tonsils and adenoids removed for correction of defects of articulation alone. Too often one hears the following history: "My child could not say certain words correctly, and I was advised to have his tonsils and adenoids out."

Although defects of articulation are sometimes found in patients who have badly deformed teeth or alveoli, I think that it is a mistake to conclude immediately that the one is the result of the other. One should keep in mind the number of persons who have very marked deformities of the teeth and no defects of articulation. The point I wish to stress is that patients with the aforementioned conditions should have an analysis of their speech to determine if the defects of articulation are due to the deformities or to faulty position of the tongue during articulation.

Injuries to the soft palate present a problem in many ways similar to that of cleft palate. They usually occur in older children who have mastered the problems of articulation, and so defects of articulation are not usually present. Escape of air through the nose, however, is very frequently a result of even slight injuries to the palate, especially in children. Owing to the pain caused by movements of the injured palate, the child quickly learns to articulate without any movement of his palatopharyngeal musculature, and the result is escape of air nasally with all sounds. This condition is liable to persist after repair and healing have taken place. The escape of air through the nose in these cases, therefore, is due not only to the resulting scarring and shortening of the palate but also to the fact that the patient has acquired a new speech habit. He has forgotten how to use his palatopharyngeal sphincter. The treatment is the same as that used in the postoperative therapy of cleft palate. The patient must be encouraged to direct the air stream through the mouth instead of through the nose. I think that in these cases, if the child is old enough, electrical stimulation of the palate is useful. However, I think that the best exercise is to have the patient watch the movements of his own palate in a mirror at least two or three times daily. For these patients, as for patients suffering from cleft palate, treatment should not be delayed until bad speech habits are firmly established.

Miss Budden, Miss Hyde, Mrs Ismay and the Province of Quebec Society for Crippled Children gave willing and valuable assistance in this work.

#### ABSTRACT OF DISCUSSION

DR V H KAZANJIAN, Boston. In cases of cleft palate some of the anatomic structures involved in speaking are deficient. The most important deficiency is associated with the soft palate, which in most cases, even if operation is successful, is shorter and stiffer than the normal palate. This is not the only defect. Some patients, especially adults, have marked distortion and irregularities of the teeth and defects of the upper lip and nose which undoubtedly contribute to the difficulty of their speech. When the patient does not have the best functioning machinery he naturally tries to use whatever means he is equipped with, and as a result the physiologic coordination of the various tissues which enter into the mechanism of speech is not perfect. Then, also, some parts remain underdeveloped while others become overdeveloped. For instance, many children with defective speech do not

make proper use of the tongue. Again, some patients do not make proper use of their lips. In other cases the muscles of the pharynx, especially the superior constrictor muscle, seem to be very active. This is often seen in patients who have not been operated on for repair of the palate.

Patients with cleft palate, especially adults, develop a false sound image, that is, their ears are not properly trained to be conscious of their own improper speech. Therefore, it seems to me that the first step in training these patients is to educate their ears to distinguish defective speech from the normal. Unless they are made conscious of this fact, there will be no intelligent effort on their part to correct their speech.

The second step is to teach them the correct use of the tongue and lips. Dr. Scharfe has given an excellent outline of his method of approach. However, above everything else it is highly important to equip the child with as good an anatomic mechanism for speech as is possible with surgical measures or prosthesis. For this reason it is important to correct the minor or major defects of the palate, nose and teeth. From this point of view the surgeon cannot dodge the responsibility by merely turning the child over to a teacher for speech training.

However, it is gratifying for surgeons to see patients not equipped with a long palate gradually learning to speak properly under proper supervision. For this reason, Dr. Scharfe's contribution is instructive and timely.

DR. G. M. DORRANCE, Philadelphia. A peculiar thing about the patient with a cleft palate is that he does not distinguish between his speech and that of a normal person. The normal child is taught to speak gradually, or develops speech by self-instruction. The child with a cleft palate goes through the same motions of speech as the normal child but does not produce the same sound. That is the real difficulty.

The attainment of good speech in cases of cleft palate requires complete velopharyngeal closure. Such closure is obtained by an operation which permits the velum to come into contact with the pharyngeal wall, so that the "palatopharyngeal sphincter" shuts off the nasopharynx. The more efficient the closure, the more satisfactory the speech.

The essential factor, then, is reconstruction of the sphincter. The operator must select an operation that in the individual patient before him will produce this closure. Unless the operative procedure undertaken results in velopharyngeal closure, so far as good speaking voice is concerned it is a failure.

When the palatopharyngeal sphincter contracts, it shuts off the nasopharynx from the oropharynx. In cases of cleft palate the anterior segment of the muscle forming the pharyngeal ring is split, and the separate ends are far apart.

I advise operating on the child with cleft palate in the fourth or fifth year. I have had no deaths, no complete failures and seldom any partial failures and no large sloughs. The older the child, the thicker the palatal tissues. If a good velopharyngeal closure is not obtained, it makes little difference when one starts speech training, but if pharyngeal closure is good, speech becomes satisfactory whenever training is started.

The teeth should be regulated, and openings in the dental arch must be corrected before proper speech can be expected.

Success comes easier and more frequently to a team of surgeons, dentists and instructors in speech.

DR. ERNEST E. SCHARFE, Montreal. I wish to stress that it is necessary to use a standard classification of speech when reporting results of treatment of cleft

palate and that defects in articulation should not be neglected in the treatment. From the patient's point of view, the correction of these defects is as important as eliminating the escape of air nasally. All have seen patients with cleft palate with defects in the palate, and yet their speech was understandable. On the other hand, I have at least two patients who have perfect palatopharyngeal sphincters and whose speech is not understandable, owing to defects in articulation alone. So my plea is that a standard classification for speech be adopted when reporting results.

# A NEW PROCEDURE FOR THE TREATMENT OF WEB IN THE LARYNX

REPORT OF A CASE

SAMUEL IGLAUER, M D

CINCINNATI

A web or diaphragm in the larynx may either occur congenitally or be acquired in the form of adhesions following injury to or ulceration of, the laryngeal mucosa. A congenital web almost invariably occurs in the form of a membrane uniting the vocal cords at the anterior commissure and extending backward for a variable distance. According to Himmelreicher,<sup>1</sup> Radasch<sup>2</sup> and others, the congenital web represents an arrested development of the larynx. In the embryo the division between the air and the food passage is present during the middle of the second month. In the larynx the two arytenoid mounds and the future vocal cords are in approximation and begin to separate from behind forward during the third month. The failure or arrest of this process leads to the presence of a congenital web. The web is always thickest at the anterior commissure and tends to thin out toward the posterior free border. It is covered with epithelium on both its upper and its under surface, and may contain connective tissue, muscle fibers, glands and cartilage.

A perusal of the literature shows that a congenital web is of very infrequent occurrence. An acquired diaphragm, resulting from the formation of scar tissue within the larynx, may occur in any portion of the lumen. Adhesions may unite the vocal cords, but the most common obstruction is usually found in the subglottic area.

The symptoms pointing to the presence of a laryngeal web vary with the site and extent of the obstruction. There is more or less interference with the production of voice, stridor may be present and dyspnea may become manifest on exertion. Indirect or direct laryngoscopy reveals the presence of the obstruction.

## TREATMENT

A review of the more recent literature shows that the treatment of webs uniting the vocal cords has not been very satisfactory and that

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1 Himmelreicher, G. Kongenitale Stimmbanderverwachsung, Arch f Ohrenh-, Nasen- u Kehlkopfh **101** 169, 1917

2 Radasch H. E., quoted by Clerf<sup>3</sup>

mere division of the web in the midline has usually been followed by the reformation of the adhesion especially at the anterior commissure, where the web is thickest and the motion limited

McKenzie<sup>3</sup> expressed the following opinion

When discovered accidentally and causing no symptoms—the usual event—it is better left alone. If stridor, dyspnoea, or hoarseness necessitate treatment, the structure may be cautiously destroyed by diathermy cauterization. Simple incision affords only temporary relief as the web reforms, and removal through thyro-fissure opening is no better. After its destruction the glottis should be kept patent by a vulcanite tube.

Hodge<sup>4</sup> recorded a case of a web in a 9 year old boy. He made an incision along one cord and then used metal dilators repeatedly. After two months there was a slight reformation of the web at the anterior commissure. The web was again incised and weekly dilations carried out with no evidence of recurrence. The voice gradually improved, but the patient remained somewhat hoarse.

At the 1931 meeting of the American Laryngological Association, Clerf<sup>5</sup> reported three cases of congenital stenosis. Two of the patients were infants and were successfully treated by division of the membrane, combined with tracheotomy and repeated dilations to keep the incised edges apart.

Schroder<sup>6</sup> employed laryngofissure with excision of the diaphragm. He then sutured the mucosa over the raw surfaces remaining after the removal of the web. The stitches pulled out on one side adhesions reformed and the patient was discharged with the anterior third of the cords reunited.

Kriegsmann<sup>7</sup> reported a case in which at intervals he employed the knife and punch, the diathermy knife and coagulation and finally repeated incisions and daily bouginage. He came to the conclusion that he would recommend surgical measures for a congenital web only as an operation of necessity and would not expect an ideal result but would be content with dividing the web in its thin posterior portion. With "thick membranes" he would advise laryngofissure with removal of the web and keeping the larynx open until healing had occurred.

3 McKenzie, D. Diseases of the Throat, Nose and Ear, St. Louis, C. V. Mosby Company, 1928, vol 1, p 110.

4 Hodge, G. E. Congenital Web of the Larynx, *Canad. M. A. J.* **22** 535 (April) 1930.

5 Clerf, L. Congenital Stenosis of Larynx, *Tr. Am. Laryng. A.* **53** 207, 1931.

6 Schroder, K. Ueber 3 Falle von stenosierender Kehlkopfmissbildung, *Ztschr. f. Hals-, Nasen- u. Ohrenh.* **28** 182, 1931.

7 Kriegsmann, G. Zur operativen Behandlung des Diaphragma Laryngis Congenitum, *Ztschr. f. Hals-, Nasen- u. Ohrenh.* **33** 218, 1933.

Beck<sup>8</sup> came to a similar conclusion. He stated that "various methods of treatment of laryngeal diaphragms have hitherto not been completely satisfactory." He reported an unusual case in a 16 year old girl who had been operated on in 1921 and again in 1932, with a recurrence of all her symptoms by the following year. He therefore performed laryngofissure and inserted a rubber tube for three weeks, after which the opening was closed. Eleven months later the glottis was free, but there was firm cicatricial tissue at the anterior commissure.

A year ago Wilkinson<sup>9</sup> reported a case in which a midline incision was made and bouginage employed. Subsequently a second incision became necessary. The final result showed the glottis about four-fifths patent.

In Tucker's<sup>10</sup> recent case repeated incisions were found to be necessary to prevent adhesions, and at the time his article was written there was still some fusion of the cords at the anterior commissure, for which further incisions were recommended.

In addition to the methods of treatment mentioned here, Haslinger<sup>11</sup> succeeded in preventing the reformation of adhesions by inserting a small silver plate between the severed tissues, but this method carried with it some danger of exciting perichondritis.

Jackson<sup>12</sup> advocated an incision to release the web on one side only, followed by daily endoscopic dilation to prevent union. Later, if necessary, the redundancy on the other side was removed.

Arbuckle<sup>13</sup> recommended the use of surgical diathermy as a means of destroying scar tissue within the larynx.

A few months ago a patient with a cicatricial web between her vocal cords came under my care. Mindful of the uncertain results achieved by the usual methods of treating a laryngeal web and considering the analogy between webbed fingers and a laryngeal diaphragm, I decided to apply the principle of the two stage operation sometimes employed by the general surgeon for the treatment of syndactylism. This consists

8 Beck, K. Ueber eine operative Behandlung des sogenannten Diaphragma des Kehlkopfes, *Ztschr. f. Hals-, Nasen- u. Ohrenh.* **35** 303, 1934.

9 Wilkinson, R. W. Congenital Stenosis of Larynx, *J. A. M. A.* **102** 1756 (May 26) 1934.

10 Tucker, G. Congenital Web of the Larynx, *Arch. Otolaryng.* **21** 172 (Feb.) 1935.

11 Haslinger. Synechie im vorderen Anteil der Stimmbänder, *Zentralbl. f. Hals-, Nasen- u. Ohrenh.* **8** 496, 1926.

12 Jackson, C. Personal communication to the author. *Surgery of the Larynx and Trachea and Endoscopic Surgery of the Bronchi*, in Lewis, Dean Practice of Surgery, Hagerstown Md., W. F. Prior Company, Inc., 1930, vol. 4 chap. 7, p. 5. *Peroral Endoscopy*, St. Louis, Laryngoscope Company, 1915, p. 430.

13 Arbuckle, M. Treatment of Cicatricial Stenosis of the Larynx, *Tr. Am. Laryng. A.* **54** 63, 1932.



in passing a wire through the proximal portion of the web between the fingers and leaving the wire in place until the epithelium has grown through from both surfaces, forming a new commissure. At the second operation the web between the fingers is completely divided, the epithelium-lined commissure preventing adhesions from reforming.

#### REPORT OF CASE

*History*—Mrs. A. F., aged 26, came to me for treatment on Dec. 6, 1934. Her chief complaint was hoarseness. She stated that she had been treated for laryngeal papillomas beginning at the age of  $4\frac{1}{2}$  years. The papillomas had been removed on fifty-two occasions over a period of from two to three years.

About eighteen months after treatment had been started, a tracheotomy tube had been inserted and had been worn for two years. After insertion of the tube no further laryngeal treatments were given, and she was pronounced free from papillomas at the age of  $7\frac{1}{2}$  years. There had been no treatment thereafter. There was a history of typhoid and diphtheria without any residua.

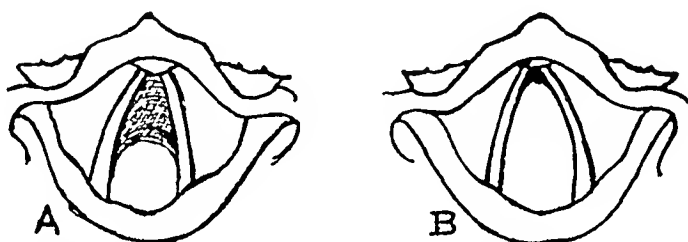


Fig. 1—*A*, a sketch of the cicatricial web between the vocal cords. *B*, the appearance of the larynx about two months after operation. (Sketch by Dr. John Myers.)

A tonsillectomy was performed under ether anesthesia in June 1934 and the patient was told that she took the anesthetic very poorly, and had required inhalations of carbon dioxide and oxygen together with injection of epinephrine as restoratives.

General physical examination revealed nothing bearing on her case. Wassermann, Hecht-Gradwohl and Kahn tests (taken later) were all negative.

*Examination*—The patient was well developed and well nourished. She was of a rather nervous temperament. A vertical keloid scar was present at the site of the former tracheotomy. Her voice was low-pitched, coarse and hoarse. She spoke with some effort. There was no dyspnea or stridor unless she became excited. She cleared her throat frequently, but was free from cough. Mirror examination of the larynx showed normal false vocal cords and arytenoid cartilage without impairment of the movements of the cartilage. There was a well defined web between the vocal cords, extending from the anterior commissure to the middle of each cord (fig. 1*A*). The free border of the web was thin, crescentic and whitish. The remainder of the web had the color of the laryngeal mucous membrane. The web apparently increased in thickness toward the anterior commissure. Laterally, it fused with each cord. On phonation, it folded up between the cords. There were no papillomas in the larynx.

*Operation*—On December 7, with the area under cocaine anesthesia, a Haslinger directoscope was introduced, and a knife puncture was made through the web near the commissure (A specially modified Bard Parker knife and handle were used for this purpose) A spring ring (from a watch chain), to which a long piece of thin copper wire had been soldered, was held open by a laryngeal forceps and inserted through the puncture The spring was then released, closing the ring The attached wire was brought out through the pharynx and nose A piece of rubber tubing was slid over the wire, which was held in place with adhesive plaster attached to the cheek (fig 2)

During the following week the patient complained of some soreness in the throat, occasional gagging, a slight cough and some difficulty in swallowing On the fifth postoperative day a roentgenogram of the neck was taken This showed



Fig 2—A lateral roentgenogram showing the spring ring anchored in the laryngeal web R indicates the ring, *W* *W* *W*,<sup>1</sup> the wire

the ring in good position within the larynx, but the wire had broken (fig 2) It therefore became necessary to remove the ring This was done the following morning, at which time the second operation was performed

On December 13 the larynx was cocaineized by the drop method, and a Haslinger directoscope was inserted When cocaine was applied through the directoscope the ring became detached and was removed with a forceps The web was then excised by a V-shaped incision beginning at the hole left by the ring, and small remaining fragments were removed with a punch forceps The piece removed measured approximately 8 mm in diameter and varied from 1 to 2 mm in thickness The microscopic report read "Dense highly vascular, subacute and chronically inflamed fibrous tissue covered in part by epithelium, some of which appears to be proliferative in character There are several small areas showing epithelial erosion of an ulcerative character"

*Subsequent Course*—Following the second operation there was a slight tendency for the adhesions to reform near the anterior commissure. In order to counteract this, four days after the web had been excised an O'Dwyer intubation tube was inserted and allowed to remain for two days. Thereafter the intubation tube was inserted for from one to two hours at intervals of from four to seven days. The patient was advised to practice vocalization with her voice placed at a higher pitch. At the end of a month she was dismissed. At that time she spoke with less effort, and her voice was improved but was still hoarse and low-pitched. A slight adhesion (about 1 mm.) was still present at the anterior commissure.

Through the kindness of Dr. John Myers, the patient was reexamined in Kansas City, where she resided. About two months after operation he reported that there was a web of from 2 to 2.5 mm. in the anterior commissure (fig. 1 B) and that the cords moved and coapted properly, but that her voice was "husky and heavy."

Four months after operation the patient wrote: "I have spoken aloud several times. This strange, new voice is at its best in the morning. In the evening it is almost entirely gone. This voice sounds as though I was recovering from laryngitis. It seems funny to possess two voices."

#### COMMENT

By the method of treatment employed in this case, a very fair but not entirely perfect anatomic and functional result was obtained. As stated previously, the breaking of the wire attached to the ring rendered it necessary to remove the latter before the time originally planned. Within limits, the longer the ring can be retained the better the chances of obtaining an epithelium-lined commissure, which is essential for the success of this procedure. If I repeat this operation on another patient, I shall allow the ring to remain in the larynx for about three weeks and shall use a piece of braided silk instead of wire to anchor the ring. This will be more comfortable for the patient.

It is questionable whether the ring technic could be carried out on an infant without resorting to tracheotomy as an adjuvant.

#### SUMMARY

A review is given of the various methods of treatment of a laryngeal web as reported in the more recent literature.

A new, two stage procedure, based on an operation for syndactylism, has been applied to the treatment of a laryngeal web.

The operation consists of inserting an indwelling spring ring through a puncture in the web at the anterior commissure.

After epithelization has occurred about the ring, the web is removed by a V-shaped excision with its apex at the newly formed commissure.

A case is reported in which this technic was carried out.

# STAPLES AND DOUBLE-POINTED TACKS AS FOREIGN BODIES

## MECHANICAL PROBLEMS OF BRONCHOSCOPIC EXTRACTION

CHEVALIER JACKSON, M D

AND

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PHILADELPHIA

A double-pointed object requires no definition, its name is definitive. The reason it requires separate classification arises from the peculiar and enormously greater difficulties of safe endoscopic removal as compared with those of removal of single-pointed objects. Staple is the name applied to a double-pointed nail used for fastening wires to wood. Double-pointed tacks are used chiefly for laying floor matting. Double-pointed wires used in machine-made baskets, automobile upholstery pins, some kinds of paper-clips, metal fasteners and some kinds of hairpins belong in the same category.

From the all-important point of view of the solution of the mechanical problem of peroral bronchoscopic removal there are two classes of bodies, the bendable and the unbendable. Figures 1, 2 and 3 give a good example of the bendable class. Figures 5, 10, 11, 12, 13, 14, and 15 are good illustrations of the unbendable and unbreakable type.

### INCIDENCE AND ETIOLOGY

From the literature one would suppose that double-pointed objects are rare as foreign bodies, but in the annals of the bronchoscopic clinic they seem to be not uncommon. There are in our records fifty-one cases of double-pointed objects as foreign bodies, of which twenty-seven have been of the unbendable, unbreakable class; in twenty-four cases the type was unclassified.

As noted many years ago,<sup>1</sup> one of the fundamental causes of foreign body in the air and food passages is carelessness in putting inedible substances in the mouth. Staples and double-pointed tacks occurred as foreign bodies as the result of being put in the mouth (*a*) by children who used them as toys or (*b*) by adults who held the staple or the double-pointed tack in the mouth while waiting to drive it in the course of work. One remarkable case of the latter group may be cited.

CASE 3051.—A man aged 56 was standing on top of a step-ladder substituting staples for nails in a ceiling. He was holding in his mouth two staples and a

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1 Jackson, Chevalier. Foreign Bodies in the Larynx, Trachea, Bronchi and Esophagus Etiologically Considered, Tr. Sect. Laryng. Otol. & Rhin., A. M. A., 1917, p. 36.

nail with which to make holes to facilitate driving in the staples. In pulling an old nail from the ceiling with pliers the nail came away so suddenly that the patient fell from the ladder, and in so doing he inspired into the tracheobronchial tree the two staples and the nail he was holding in his mouth (fig 15)

No case of a staple as a foreign body has so far occurred as the result of accidental presence in food

Prophylaxis is simple in principle. If no one put such inedible things in his mouth these accidents with foreign bodies would not occur. In practice, however many difficulties are encountered. The slack oversight many parents give their children, the difficulty of eternally watching the very young child, force of habit in adults and ignorance of danger on the part of parents and workmen all call loudly



Fig 1—A double-pointed automobile upholstery pin lodged points upward in the bronchus of the right lung of a boy aged 10 years

for a campaign of education in the prevention of these and other accidents with foreign bodies. Very young children should not be permitted to play with such potentially dangerous objects, and older children should be taught not to put them in the mouth.

#### PATHOLOGIC CHANGES

When a staple first reaches a bronchus the local reaction is moderate because the foreign body is of metal and is not obstructive, there is free by-passage space for ventilation and drainage. Before long, however, because of the hereinafter mentioned characteristics the staple works a little deeper and the points become covered with a proximal annular edema that hides the view of the points as approached with the bronchoscope from above (fig 5). The foreign body undergoes

changes, the galvanizing or tinning, if either is present, is soon lost by galvanic action<sup>2</sup> the steel corrodes rapidly and its roughened surface introduces infection under the epithelium the mucosa swells, granulations form and the by-passage spaces are obliterated. This obstruction to ventilation and drainage soon results in suppuration in the tributary area of the lung. At first the condition is one of drowned lung, that is the pus is contained in the normal passages. If the foreign body is not removed the walls of the natural passages break down and pulmonary abscess results. The suppuration is almost invariably foul. We have noted<sup>3</sup> in cases of prolonged sojourn of the foreign body a remarkable resistance to suppurative invasion by the bronchial route as compared with that by the lymphatic or the vascular route. We have evidence also that metallic substances in the bronchi in undergoing oxidation inhibit the suppurative process by

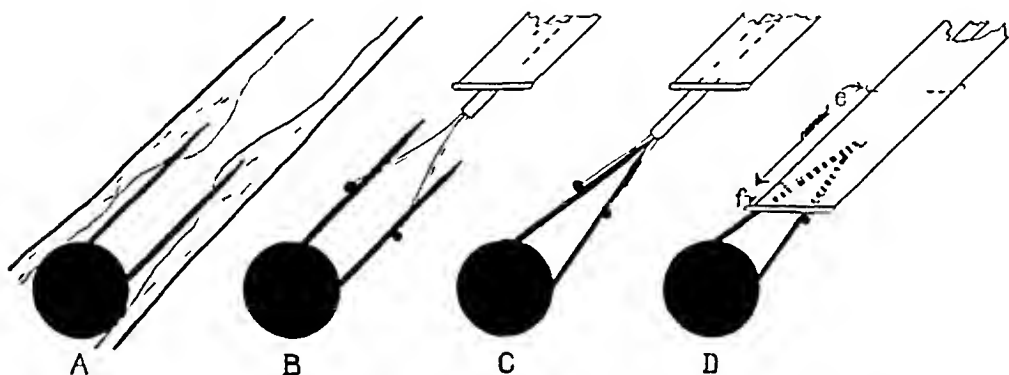


Fig 2—Schema illustrating the solution of the problem of the bendable type of double-pointed foreign body presented in figure 1. At A is indicated how elongation and shortening of the bronchi have buried the points in the mucosa, to make traction would drive these diverging points outward through the bronchial wall, frustrating removal and inflicting serious trauma. A slight push downward is sometimes necessary to release the points. At B is illustrated the application of the approximation forceps. At C the points are approximated. At D the bronchoscope is shown pushed from *e* to *f* down over the approximated points, safely sheathing them for withdrawal. Note that the sheathing is not done by traction on the forceps.

ionization<sup>2</sup>. The pathologic changes in the tissue and their relation to the changes in the foreign body itself have been considered elsewhere<sup>4</sup>.

2 Jackson, Chevalier. Observation on the Pathology of Foreign Bodies in the Air and Food Passages Based on the Analysis of Six Hundred and Twenty-Eight Cases, *Surg, Gynec & Obst* 28 201 (March) 1919.

3 Jackson, Chevalier. (a) Suppurative Diseases of the Lung Due to Inspired Foreign Body Contrasted with Those of Other Etiology, *Surg, Gynec & Obst* 42 305 (March) 1926, (b) Peroral Endoscopy and Laryngeal Surgery, St. Louis, The Laryngoscope Company, 1915. (This book is out of print, but is in most libraries. The French translation, entitled "Endoscopie et chirurgie du larynx," is still obtainable from the publisher, Gaston Doin, Paris.) Footnote 2.

4 Jackson, footnotes 2 and 3.



Fig 3—Roentgenograms showing a double-pointed fastener lodged point upward in the bronchus of the lobe of the left lung of a boy aged 11 years. The foreign body being bendable, the points were made one by approximation and were then sheathed in the mouth of the tube for withdrawal. The foreign body had been in the lung three and one-half years, yet being of brass, the corrosion of the metal had not been sufficient to dull the sharpness of the points or to cause breakage.



Fig 4—Roentgenogram of a baby aged 8 months, showing a double-pointed bassinet wire fastener entangled in the walls of the cervical esophagus. All instrumentation was contraindicated for ten days after admission. The swollen tissues full of air had almost asphyxiated the baby. The subcutaneous emphysema and cellulitis were due to alternate pulling and pushing on the foreign body before admission. The mechanical problem was of one point resisting upward traction and another resisting the downward propulsion necessary to free the penetrated upward point. The solution was to free and sheathe the upper, straight point, the curved point did not resist upward traction. This case is illustrative of contraindications to the approximation method.

## SYMPTOMATOLOGY AND PROGNOSIS

It is fundamental to remember that the symptoms presented depend largely on the stage at which the patient is seen. The patient may be entirely symptomless or he may be moribund from prolonged chronic sepsis with or without exsanguinating hemorrhages. The initial symptoms are coughing, choking and gagging, these are practically never absent, but in children they may go unobserved. The cough subsides in a few minutes or hours, then follows a prolonged symptomless interval. After a few weeks or months productive cough develops, and the sputum is increasingly purulent, foul and blood-tinged. Pallor and emaciation progress and clubbed fingers and watch-crystal nails complete the syndrome of chronic pulmonary sepsis. In the early stages there is usually no fever, later the temperature is of the daily fluctuating septic type, usually with a moderate high point. The pulse ranges rela-



Fig 5 (case Fbdv 409)—The patient was a man aged 43. The illustration gives a bronchoscopic view of a large fence staple of galvanized steel which had been in the main bronchus of the left lung for two years. Acute edema due to previous efforts at removal masked the chronic lesions somewhat. Localized bronchitis and perichondritis were present. The ring of reddish swelling hiding the upward-projecting points was fibrous inflammatory tissue. There were granulations deeper down below the fibrous ring where the staple had been lying. The points were removed by means of the bronchoscope through the mouth by cephalic version, the points being disembedded, brought upward and turned down into the bronchus of the right lung, the orifice of which is shown to the right. The limitation of the inflammation after two years was remarkable. The carina was not thickened, and the right bronchial orifice was normal.

tively to the range of temperature. Respirations, unaffected in the early stages, increase in rate later. Leukocytosis is usually less in degree than in most other suppurative pulmonary conditions.

There is no immediate danger to life, but ultimately the secondary pulmonary suppuration will prove fatal. The prognosis as to removal is good, all such objects can be removed through the mouth, practically without mortality if no injudicious efforts at removal have previously created potentially fatal complications.



## MECHANICAL PROBLEMS OF ENDOSCOPIC EXTRACTION

The fundamental principle in dealing with all pointed objects is that advancing points perforate whereas trailing points are relatively harmless (fig 7). As with single-pointed objects, we have worked out methods of dealing with double-pointed objects that are almost always successful, and when used with care these methods have practically eliminated all danger to the life of the patient.

*Bendable and Double-Pointed Objects*—The characteristic of foreign bodies of this class is that, the foreign body being bendable, the two points may be approximated and may thus be made one (figs 1, 2 and 3). This one, combined point may be sheathed with the mouth of the tube or otherwise before it is advanced upward. Double-pointed pins, paper-clips and metal clips are common examples of foreign bodies to which this approximative technic is well adapted. Hair pins con-

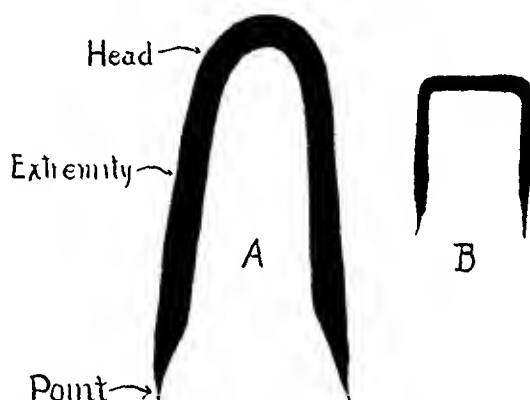


Fig 6—Illustration of the nomenclature given to parts of the staple (A) and the double-pointed tack (B) useful for brevity and clearness of description of manipulations in the solution of mechanical problems of endoscopic removal of foreign bodies. The curved part is called the head because it is where the hammer strikes, and it corresponds to the head of a nail. The extremities of the staple diverge at a small angle. The extremities of the double-pointed tack are parallel. Either object may have been deformed before it became a foreign body, the points may be eaten away by oxidation after a long sojourn. It is well to learn of such changes by roentgen examination before planning the technic of removal.

sidered as foreign bodies are of two kinds. The standard model, with two separated and sharpened points, when lodged points upward, as it usually is, requires approximation and sheathing of the points before removal.<sup>2</sup> The recently devised "bobette" or sliding pin has two ends, but they are tightly approximated and moreover are not potentially traumatizing because they are not pointed. These pins as foreign bodies have been considered elsewhere.<sup>5</sup>

5 Jackson, Chevalier, and Jackson, Chevalier L. *Bronchoscopy, Esophagoscopy and Gastroscopy*, ed 3. Philadelphia, W. B. Saunders Company, 1934.

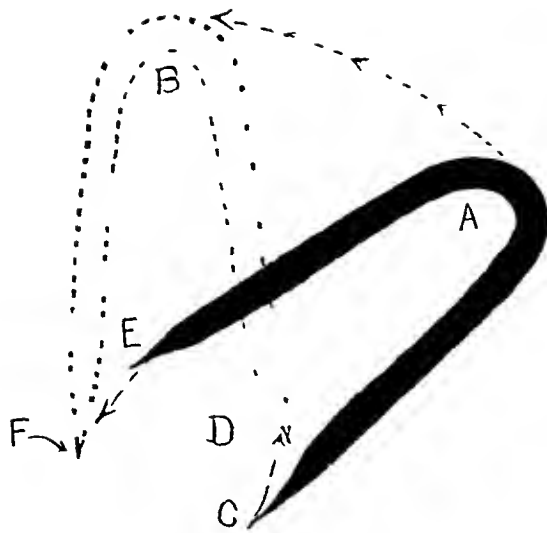


Fig 7—Schematic illustration of the fundamental principle of safety in dealing with sharply pointed foreign bodies, namely, "advancing points penetrate, trailing points do not" (Jackson, C Ann Surg 75 1 1922 footnotes 3b and 5) If the staple, *A*, is rotated in the plane of the extremities in the direction indicated by the curved darts the point, *E*, becomes an advancing point, it rips in at *F* and will penetrate if movement is continued. On the other hand, the same movement of the foreign body at the same time causes the other point, *F*, to retreat to *E*, its relation to the tissues becoming a trailing point with no danger of trauma so long as movement continues in this direction. Therefore, during version in the direction of the curved darts *A* to *B* the point *C* may be disregarded as harmless because its movement is trailing. On the other hand, the point *F* must be guarded with utmost care because the same movement of the foreign body that causes the point *C* to trail causes the point *F* to advance. If point *E* is properly controlled, complete version in the plane of the extremities may be safely accomplished and the foreign body delivered by the head with points trailing.

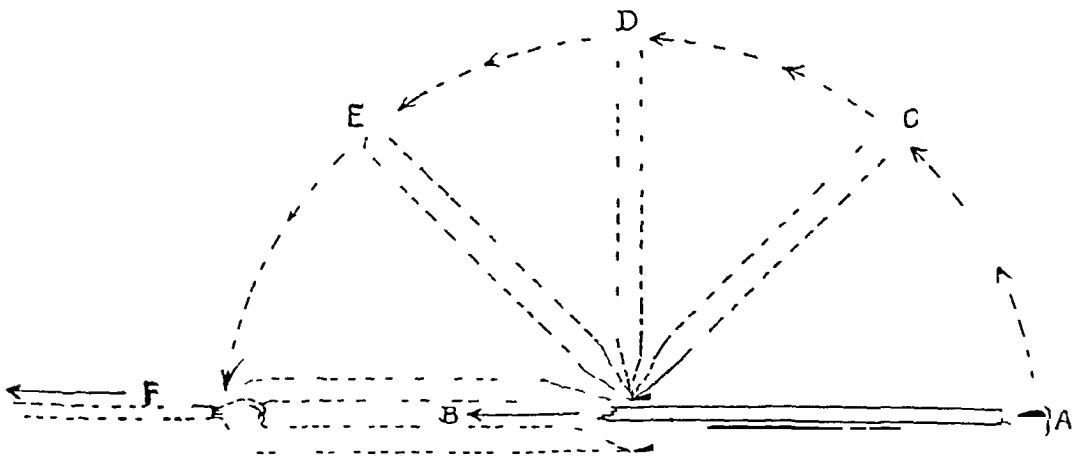


Fig 8—Schematic illustration of cephalic version vertical to the plane of the extremities. When traction on the head of the staple *A* is made by the forceps in the direction of the dart *B* both points are advancing points, they rip into the tissues and come to a standstill. Continuation of traction causes the head to rise vertically to the plane of the extremities until position *C* is reached, then, if traction is continued version is completed (*D*, *E* and *F*) and results in delivery by the head, in the direction of the dart *F*, with both points trailing. Obviously, considerable penetrating pressure is put on the wall of the bronchus by the points. If the length of the staple exceeds by more than 3 mm the transverse diameter of the passage invaded the danger increases in direct proportion to the length. The rotation forceps are used for this, they must be perfectly adjusted.

*Unbendable, Unbreakable, Double-Pointed Foreign Bodies*—The foreign bodies in this class most frequently encountered are staples and double-pointed tacks—especially staples (figs 5, 10, 11, 12, 13, 14 and 15). These may cause fatal results if removal is attempted without a perfect conception of the potentially fatal character of the foreign body when manipulated. Their characteristics are: 1. They are made of rigid steel to render it possible to drive them into wood. 2. The points are very sharp and penetrate easily because they are triangular in cross-section like surgical needles. 3. The branches in most instances diverge at a small angle directing the points toward the walls of the

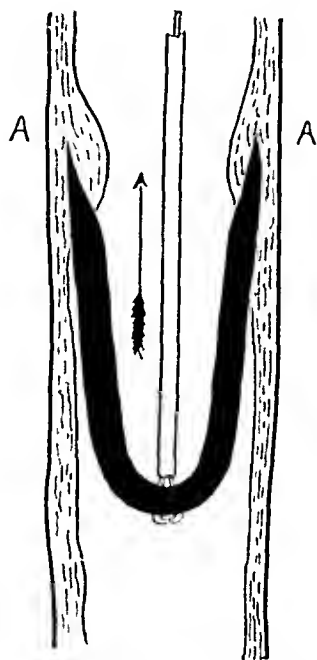


Fig 9—The points *AA* of a staple are almost always buried because of the elongation and shortening of the bronchi or, sometimes, because of injudicious traction in the direction of the dart. Compare with figure 5.

invaded passage, which renders the points certain to rip into the walls if traction is made. 4. The shape of the foreign body favors its working deeper into the tracheobronchial tree by a ratchet-like action. Under enlargement and diminution of the lumen and elongation and shortening of the bronchi at each respiratory cycle and at each cough the head slips down easily, but upward movement of the foreign body is prevented by the points ripping into the bronchial wall, the result is that the foreign body is forced down into the smallest bronchus it can enter and the points are buried below a proximal ring of edema, so that through the bronchoscopy only the central part of the head is seen (fig 5).

When traction is made on a staple lodged point upward, because of the divergence of the extremities one or both of the points almost always enter the bronchial wall, preventing upward movement of the foreign body. To release the foreign body it is necessary to push downward, and unless great care is taken it will be pushed to a lower position than it previously occupied. Patients have come to our clinic with staples that by repeated pushing and pulling have been forced toward the periphery as far as their size would permit them to be pushed, this enormously increased the difficulties of safe disentanglement, though in no case has safe bronchoscopic removal been rendered impossible.

Corrosion may have destroyed the points of a staple so that they do not catch in the bronchial wall. In such cases the foreign body



Fig 10 (case Fbdv 2944) —Anteroposterior and lateral roentgenograms of a boy aged 17 showing a large staple in the bronchus of the left lung. The history indicated that it had been lodged in the orifice of the left bronchus two years previously and had worked downward to the position indicated here. It was embedded in a suppurating bed surrounded by granulation tissue. Removal was accomplished through the mouth by means of a bronchoscope after cephalic version. The divergence of the extremities and the sharpness of the points are well shown.

may slide upward when traction is made, and if the intruder is rotated so as to bring the plane of corroded points to correspond with the sagittal diameter of the glottis it may come through. If such a foreign body is in the esophagus it must be rotated so that the plane of the points corresponds to the frontal plane of the body in order to come up between the cricoid cartilage and the cervical portion of the spine.<sup>6</sup>

<sup>6</sup> Jackson, Chevalier. A Fence Staple in the Lung. A New Method of Bronchoscopic Removal, *J A M A* 64 1906 (June 5) 1917.

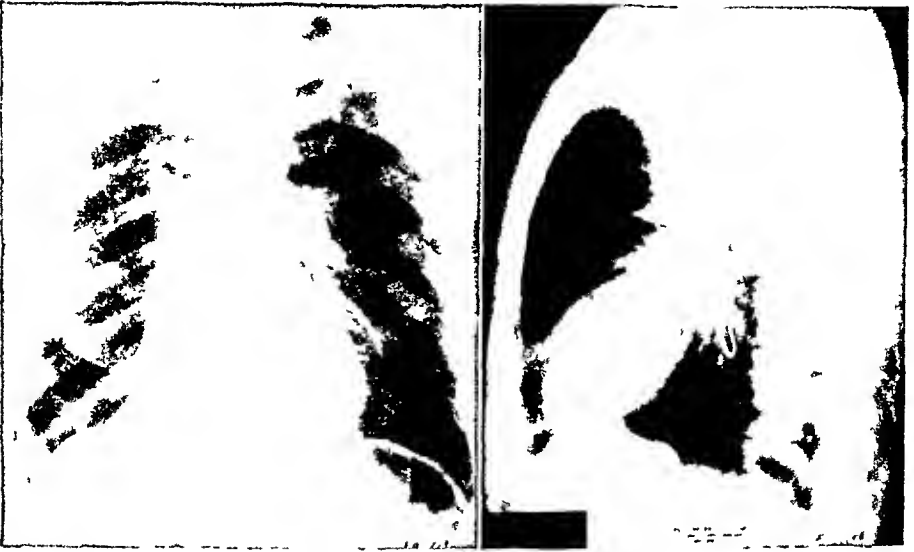


Fig 11—The length of a staple is shown in the anteroposterior projection, but in this roentgenogram the impression of the distance of separation of the points is deceptive. The equation of foreshortening as well as that of magnification must be determined by additional roentgenograms in working out a solution of the mechanical problem. The patient was a man aged 50. The sojourn of the foreign body was eleven weeks.



Fig 12—In this case the points are in a different relative plane from those in figure 11. In neither of the projections does the film show the maximum separation of the points. Another roentgenogram in the plane of maximum separation should be made. Of vital importance in removal is the proximity of the median point to the pericardium. The patient was a girl aged 9 years. The sojourn of the foreign body was one week.

Almost always, however, the points of staples and double-pointed tacks are sharp and rip into the bronchial wall in such a way as to prevent removal without either sheathing of the points or version of the foreign body

*Roentgen Examination*—Of first importance in the study of the mechanical problem of bronchoscopic extraction in a case of staple lodged in the tracheobronchial tree is the roentgen study. It will not do to go ahead with bronchoscopic removal on the basis merely of a fluoroscopic report that there is a staple in the lung. One must have roentgenograms in the anteroposterior and lateral projections and an additional one made in the plane necessary to demonstrate the greatest

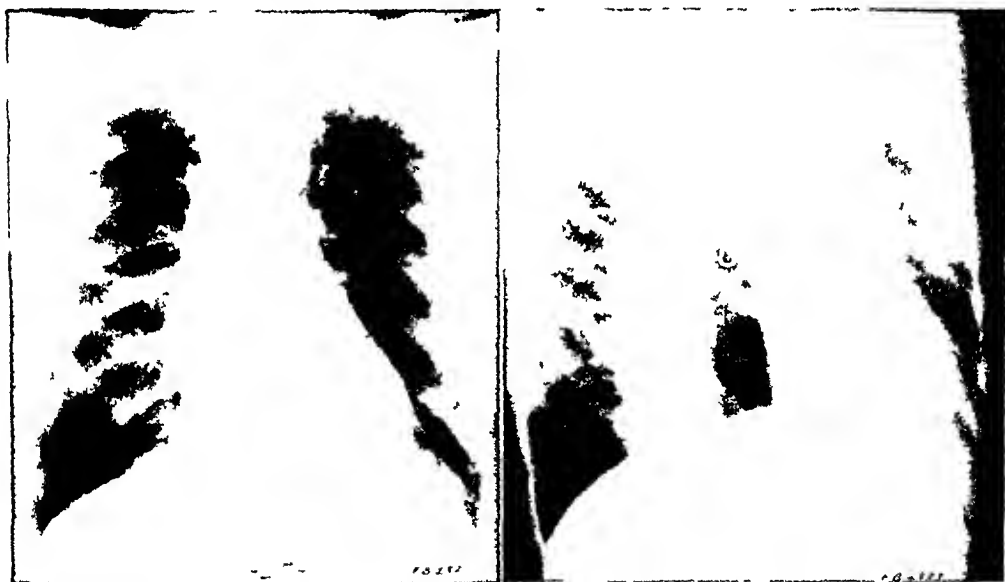


Fig 13—Anteroposterior and lateral roentgenograms of a man aged 57 showing a staple entirely within the bronchus of the middle lobe. Both roentgenograms show a foreshortened shadow, another projection was necessary to show the maximum separation and sharpness of the points, the divergence of the extremities and the full length of the staple, all of which was of vital importance in getting a proper conception of all the elements involved in the solution of the mechanical problem. The staple was removed by cephalic version in the plane of the extremities.

distance between the points, this is not only to show the spread of the staple but also to determine the position of its greater plane. Still another roentgenogram is necessary, it should be so made as to eliminate foreshortening, and thus determine the actual length of the staple (figs 11, 12, 13 and 14). The roentgenologist must do four things: (1) make proper roentgenograms, (2) indicate whether the foreign body is of normal shape or is deformed, (3) indicate whether the points have lost their sharpness by corrosion, and (4) furnish an exact duplicate

of the foreign body in the lung, duplicating size, length sharpness of the points and degree of divergence of the branches<sup>7</sup>

*Cephalic Version*—The extremities of the staple may be turned down and the foreign body delivered by the head if (a) the staple is no longer than the transverse diameter of the invaded bronchus or (b) if there are branch bronchial orifices into which the extremities can be guided. This method has been in successful use for twenty-five years<sup>8</sup>. The version may be in the plane of the extremities (fig 7) or vertical to the plane of the extremities (fig 8). The latter method is dangerous with long staples, that is, those the length of which greatly exceeds the diameter of the bronchus at the location of turning. The bifurcation of the trachea affords the greatest width of lumen for version, next



Fig 14—Neither of these roentgenograms is made in a plane to show the greatest separation of the points. A third film should be made in such a case so as to eliminate the equation of foreshortening in order to facilitate accurate matching of a duplicate for the use of the bronchoscopist in the working out of the mechanical problem. The patient was a man aged 77. The sojourn of the foreign body was nineteen days.

in width is the widening at the orifices of the bronchi of the upper and the middle lobe, lesser widenings are at the giving off of branch bronchi. In the hypopharynx the version may be done in situ. In the esophagus endogastric version is best. The foreign body is seized at the middle of the head with rotation forceps, it is then guided gently down into the stomach, where there is always plenty of room to turn it over without trauma.

7 Jackson, Chevalier, and Jackson, Chevalier L. Foreign Body in Air and Food Passages, in Case, J. T. Annals of Roentgenology, New York, Paul B. Hoeber, Inc., 1934, vol. 16.

8 Jackson, footnotes 3b and 6.

## INSTRUMENTS

Sheathing forceps are practical if the staple is fixed, otherwise the staple will rotate so as to render accurate application difficult. Two cylindrical forceps may also be used, one to sheath each point separately.

The staple bronchoscope is the best of all means for solution of the problem. By this method both points are sheathed in the mouth of the tube of our special staple bronchoscope, removal of very large staples requires the pivoted form of this special bronchoscope. The bronchoscope is gently guided down over the points, the foreign body must not be pulled into the mouth of the tube because this would cause the points to penetrate the walls. In order to facilitate the sheathing the foreign body must be fixed with the special, broad-jawed forceps,

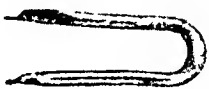
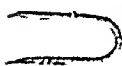
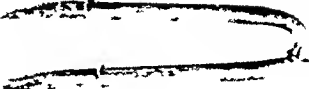
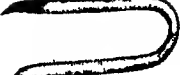


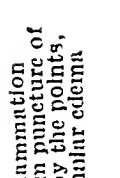
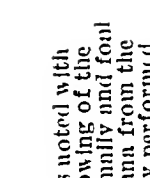
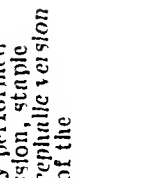

Fig 15—Roentgenogram of a man aged 56 showing two huge fence staples and a nail in the bronchi. In the anteroposterior projection the maximum separation of the points of the staple in the bronchus in the right lung is shown, but the shadow of the separation of the points of the staple in the bronchus in the left lung is deceptive. In the quartering roentgenogram the separation of the points of this staple is better shown, but it is not quite maximum, and the length is much foreshortened. The nail and the staple in the bronchial tree of the right lung were removed first by bronchoscopy, and the staple in the bronchus of the left lung in a second operation. Perfect recovery followed (case 3051 in the table).

this prevents rotation of the body. One caution is of vital importance. No traction should be made until both points are safely sheathed. In order to be certain that one point is not outside the mouth of the tube the work must be done in the fluoroscopic room so that at this critical point one may make doubly certain as to this point by fluoroscopic observation. The fluoroscopist must be impressed concerning the vital necessity for absolute certainty. The biplane fluoroscope is necessary for this work, the ordinary fluoroscope may be fatally misleading.


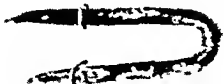




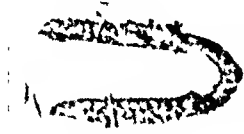
# Cases of Double-Pointed Objects in the Bronchi, Esophagus and Stomach Removed by the Oral Route

Case Number and Illustration	Age and Sex	Foreign Body	Location and Sojourn	Anesthesia	Tube	Problem	Forceps	Point of Secure	Result	Time	Comment
 Fbdy 236	1 yr	Staple double pointed	Trachea at the aortic level with the points up	None	3 mm by 30 cm broncho scope	Transfixed obliquely, points buried, lacerated posterior wall medial emphysema moribund condition of patient on admission due to previous indolent traction	Rotation	Head after version	Extraction, cure, vaginitis uninfluenced	1 1/2 hr	Died of vaginitis
 Fbdy 237	19 mo	Staple double pointed	Stem of the bronchus of the right lung with the points up	None	3 mm by 30 cm broncho scope	Points upward, sitting tightly, one point embedded in swollen mucosa, cephalic version, vertical to the plane of the extremities	Rotation	Head after version with hook	Extraction, cure	1 1/2 hr	Foreign body coaxed up and turned at the orifice of the bronchus of the middle lobe after the buried point was freed
 Fbdy 238	10 yr	Staple double pointed	Tracheal bifurcation, with the points up	None	3 mm by 40 cm broncho scope	Points obliquely upward cephalic version in the plane of the extremities	Rotation	Curve after turning	Extraction, cure	50 min	Foreign body turned at the tracheal bifurcation
 Fbdy 239	10 yr	Staple double pointed	Esophagus, below the plicae cricopharyngeus	None	8 mm by 10 cm esophago scope	Points upward, not embedded, endogastric version	Rotation	Curve	Extraction, cure	1 1/2 hr	Foreign body carried into the stomach, reversed and removed

	14 yr M	Staple double pointed	Posterior branch of the bronchus of the inferior lobe of the right lung for 15 days	Local 7 mm by 15 cm by broncho scope	Points upward, buried, proximal edema, cephalic version in the plane of the extremities	Side curved, hooks	Head after version	Extraction, cure 1 hr 24 min	Localized inflammation resulting from puncture of the mucosa by the points, proximal annular edema present
	43 yr	Staple double pointed	Main bronchus of the left lung for 2 years	Local 9 mm by 30 cm by broncho scope	Points upward, sharp and buried, large size	Side curved, hooks	Head after version	Extraction, cure 1 hr 20 min	Granulations noted with fibrosis narrowing of the lumen proximally and foal pus, no trawna from the bronchoscopy performed before admission, staple removed by cephalic version in the plane of the extremities
	1 yr M	Staple double pointed	Main bronchus of left lung for 25 days	None 5 mm by 30 cm by broncho scope	Sharp points up in a small bronchus swollen shut, points invisible and buried in the bronchial wall adjoining the pulmonary vein	Rotation	Curved end after turning (cephalic version with pointed extremities turned downward, changed to head presentation for drawal)	Extraction, cure 18 min 9 sec	Bronchus swollen almost shut, proximally
	53 yr M	Staple double pointed	Bronchus of the inferior lobe of the right lung for 11 days	Local 8 mm by 10 cm by broncho scope	Sharp points upward	Side curved	One point, the other point protected by the lip of the mouth of the tube	Extraction, cure 11 sec	Moderate localized bronchitis and streaks of scratches corresponding to movement of the points during respiration and cough, neither point hidden, no signs of trauma

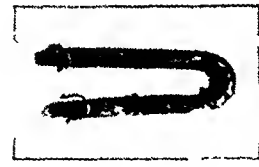
*Cases of Double-Pointed Objects in the Bronchi, Esophagus and Stomach Removed by the Oral Route--Continued*

Case Number and Illustration	Age and Sex	Foreign Body	Location and Sojourn	Anesthetic	Tube	Problem	Forceps	Point of Suture	Result	Time	Comment
 Fbdy 825	4 yr F	Staple double pointed	Trachea for 5 days	None	Laryngo scope	Points upward, buried in tissue below glottis, narrowing rigid wire sharp points, danger of foreign body dropping deeper	Rotation	Head	Extraction cure	1 min 35 sec	Points buried in the swollen subglottic tissues the posterior point readily seized and advanced up out of the larynx, the anterior point being induced to trail down ward as the curved portion was brought upward the curved portion then forced posteriorly against the membranous wall of the trachea and caused to emerge by pressure exerted in a posterior direction by the spatular tip of the laryngoscope
 Fbdy 975	7 yr M	Staple double pointed	Stem of the bronchus of the right lung for 26 days	None	5 mm by 35 cm broncho scope	Points upward, pathologic process and trauma cephalic version in the plane of the extremities	Rotation	Head version of points at the orifice of the bronchus of the upper lobe	Extraction, cure	39 min 12 sec	The foreign body found just below the orifice of the bronchus of the upper lobe was turned at the level of the bronchus of the upper lobe and removed
 Fbdy 664	48 yr F	Carpet tack	Bronchus of the left lung for 5 months	Local	9 mm by 40 cm broncho scope	Points upward, buried in swollen mucosa	Slide curved	Head end after cephalic version, vertical (presenting extremities turned down ward)	Extraction, cure	2 min 37 sec	The internal point buried in the bronchial wall, and the external point hidden by granulation tissue localized bronchitis present but the pathologic change slight considering the length of sojourn
 Fbdy 1250	8 yr M	Staple, double pointed	Main bronchus of the left lung for 6 years	None	6 mm by 35 cm broncho scope	Points upward very sharp but crumbling	Rotation	Head, after version	Extraction cure	18 min 12 sec	The history ignored the patient treated for diphtheria then for chronic bronchitis roentgen examination after 6 years revealed the foreign body bronchosopic examination revealed the bronchus inflamed and blocked with granulations just above the orifice of the bronchus of the upper lobe large quantities of pus aspirated the staple seized with a rotation forceps and turned in an abcess cavity in the lower lobe with the



Fbdy 1333

23 yr  
M  
Staple double-pointed  
Bronchus of the lower lobe of the left lung about 2 cm below the bronchus of the upper lobe for 15 years  
Length 45 cm by broncho scope  
Sharp points upward below an annular stricture  
Cure  
30 sec  
In granulation tissue and hidden by masses of fibrous tissue on each side of the bronchial walls making the lumen of stricture less in the transverse diameter than in the anteroposterior, the bronchoscope insinuated into the lumen of the stricture and both points brought into the mouth of the tube thus permitting removal of the sheathed staple without trauma to the bronchus



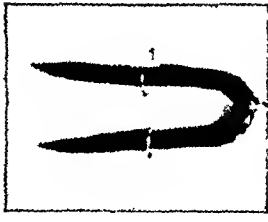
Fbdy 1440

2 yr  
M  
Staple double-pointed  
Stem of the bronchus of the lower lobe of the right lung for 8 weeks  
None  
4 by 6 mm by 30 cm staple broncho scope  
Impaction in relatively small bronchus with points hurried upward  
Broad, flat, staple  
Both points in distal mouth of the tube  
Extraction, cure  
6 min 30 sec  
A satisfactory solution of a difficult problem by the use of the special staple bronchoscope



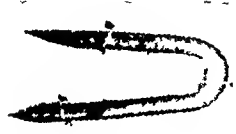
Fbdy 1581

4 1/2 yr  
F  
Staple double-pointed  
Bronchus of the left lung for 2 years 10 months  
None  
2 by 5 mm by 30 cm staple broncho scope  
In mass of pathologic tissue due to prolonged sojourn, problem of sheathing points  
Broad, flat, staple  
Points flatwise  
Extraction, cure  
18 min 45 sec  
The staple bronchoscope very satisfactory


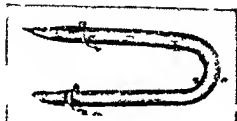
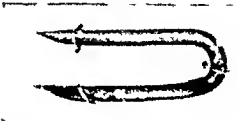



Fbdy 2034

14 yr  
M  
Staple double-pointed  
Bronchus of the lower lobe of the left lung for 7 years  
None  
4 by 6 mm by 30 cm staple broncho scope  
Covering both points of staple  
Broad staple  
Both points  
Extraction, cure  
20 min 23 sec  
Proximal annular stenosis caused by a seven year sojourn with the lumen too small to bring the staple through, dilation of the stricture by means of the tip of the bronchoscope



60 yr  
M  
Staple double-pointed  
Bronchus of the lower lobe of the left lung for approximately 11 weeks  
None  
4 by 10 mm by 40 cm staple broncho scope  
Points upward, buried in bronchial walls, cephalic version in the plane of the extremities  
Broad staple first, rotation for second  
By the point, then by the head for version  
Extraction, cure  
32 min 50 sec



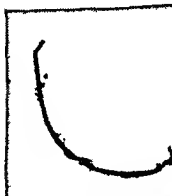
Case Number and Illustration	Age and Sex	Foreign Body	and Sojourn	Anesthetic	Tube	Problem	Forceps	Seizure of	Result	Time	Comment
 Ibdy 2327	9 yr F	Staple double pointed	Bronchus of the lower lobe of the right lung for about 1 week	None	5 mm by 35 cm broncho scope	Lodged points upward in n bronchus too small to hold the staple without burial of the points in tissue cephalic version vertical to the plane of the extremities	Rotation	By the head after version	Extraction, cure	39 min 8 sec	
 Ibdy 2329	57 yr M	Staple double pointed, medium size	Within the bronchus of the middle lobe for 4 days	None	8 mm by 40 cm broncho scope	Two very sharp points, lateral cephalic version in the plane of the extremities	Rotation	By one branch close to the head for version, then by the middle of the head	Extraction, cure	6 min 13 sec	
 Ibdy 2840	77 yr M	Staple double pointed	Posterior branch of the bronchus of the lower lobe of the right lung for 10 days	None	4 mm by 45 cm staple broncho scope	Deeply embedded in n bronchus "on the stretch", with tendency of both very sharp points to penetrate the bronchial wall	Bronchoscopic	Both pointed extremities at once	Extraction, cure	27 min 35 sec	Point sheathing method with special staple bronchoscope
 Ibdy 2941	17 yr M	Staple double pointed (largest size)	Bronchus of the left lung with the head resting on the spur between the bronchi of the upper and the lower lobes, with lowermost point buried in the median wall of the bronchus below the crura for 2 years	None	4 by 16 mm by 40 cm expanding staple broncho scope	Widely spread divergent points with the lower point buried for about 1 cm in the median wall of the bronchus in the third interannular membrane below the crura, the greatest difficulty was in disembedding lower point, the staple rotated in the center plane and delivered by the head (cephalic version) the advancing point made an arc through the widest part of the tracheobronchial tree at the bifurcation the lower limb of the arc ending in the main bronchus of the right lung, about 2 cm below 4th tracheal ring	Rotation	1st, one branch, then, by the head of the staple	Extraction, cure	37 min 40 sec	The staple embedded in fungating bleeding tissue and bathed in pus as a result of the long sojourn

the greatest difficulty from the fact that the staple was so widely spread at the point with a greater spread than the transverse diameter of the bronchus invaded, thus forcing the point into the bronchial wall, the staple was moved up into the trachea, then was tilted slightly sideways, with one point so placed that it would not rip into the trachea and the other point sheathed in the tip of the sheath of the tube, difficulty encountered in getting the staple through the pleotis because of the great spread of the points, that the better diameter of the sheath diameter of the larynx. It was manipulated through the pleotis, one of the staples and the mill is moved, no attempt being made to remove the second staple

two staples and a mill in the bronch of the same patient at the same time is unique in the literature of bronchoscopy

50 yr M	None	1 by 16 mm by 10 cm expanding staple broncho scope	Sharply pointed, with one point deeply buried in the bronchial wall	Flat, staple and rotation forceps	Rounded end	Extraction of staple and mill	
	Stem of the bronchus of the right lung with the external point engaged in the wall of the bronchus						
Null	Bronchus of the lower lobe of the right lung 5 mm from the diaphragm at the nearest point for about 1 month	1 mm by 15 cm costo phrenic broncho scope	Large mill at the pathology change from a softening 3 months discorg lung head from pathologic tissue	Forward grasping	Head		
None	Bronchus of the left lung with the head at the middle of the bronchus of the upper lobe for about 5 months	None	Points upward, with one buried below the carina in middle wall of the bronchus, problem complicated by the bad angle of approach, with the axis of the staple almost horizontal	Blair, rotation and flat forceps	Both branches after release of the distal point	Extraction of staple, cure	9 min 10 sec
9 mo	Hypopharynx, behind the trachea through the pyriform sinus for 1 days	None	None, white, very soft and malleable (commented)	Laryngeal	Near end	Extraction, cure	9 min 10 sec
	Bent wire	Laryngoscope					

*Cases of Double-Pointed Objects in the Bronchus, Esophagus and Stomach Removed by the Oral Route—Continued*

Case Number and Illustration	Age and Sex	Foreign Body	Location and Sojourn	Anesthetics	Tube	Problem	Foreceps	Point of Seizure	Result	Time	Comment
	2 mo F	Hairpin	Hypopharynx and orifice of the esophagus for about 1 month	None	7 mm by 30 cm esophago scope	Both points upward and buried in mucosa	Side curved	One point after the other point was bent inward	Traction, cure	1 min 56 sec	The child was examined by roentgenogram on the suspicion of an enlarged thymus because of stridulous respiration of one month's duration
	8 yr M	Metallic object from toy radio set shaped like a staple	Bronchus of the lower lobe of the left lung for 5 months	None	Staple broncho scope	Widely spread, sharp upward points buried in tissue	Appronation	Pointed ends after approximation	Traction, cure	37 min 40 sec	I oelized suppurative process
	12 yr M	Tonsil wire (and blood clots)	Bronchus of the right lung for 1 d 1/2	None	5 mm by 35 cm broncho scope	Stiff spring steel wire hooked into a small branch of the bronchial orifice wire doubled into the tube	Slide curved	Bight	Traction, cure	19 min 53 sec	The absence of inflammation of the bronchial mucosa notwithstanding the foreign body aspirated during a tonsillectomy firm blood clots found in both main bronchi, probably inspired during the operation blood clots aspirated

Fbdy 837

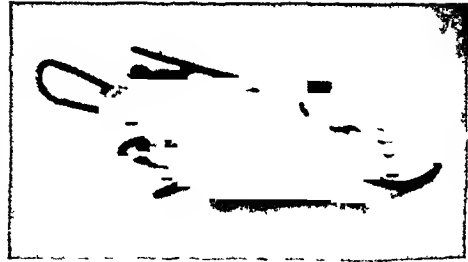
Fbdy 1472

Fbdy 1582

1773  
Fbdy 1773



Fbdy 1921

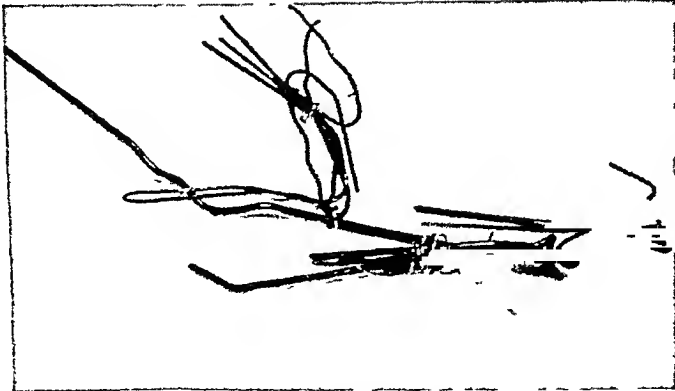



Fbdy 1939

3 1/4 yr F	Curved wire	Esophagus for 10 days	None	7 mm by 30 cm esophago scope	Widely spread upward projecting points of heavy wire	Very heavy approx imation (special)	By both branches near the end	Traction, eure	7 min 30 sec	About the limit of possi- bilities in approximation of heavy, very stiff wire
11 yr M	Metallic fastener	Bronchus of the lower lobe of the left lung for 3 1/2 years	None	4 mm by 35 cm esopho- phrenic broncho scope	Double pointed, with points upward and embedded in tissue	Slide eured	Anterior prong	Traction, eure	10 min 20 sec	The body much corroded from the long sojourn, points approximated for removal
49 yr F	Cluster of hair pins	Esophagus below the plea erico pharyngeus for 2 days	None	10 mm by 30 cm esophago scope	Sheathing of three upward projecting points	Slide eured and ratchet rotation	One point with other points held in the mouth of the tube with rotation forceps	Traction, eure	12 min 20 sec	Traction difficult but managed without trauma, one point covered with the forceps, and two points sheathed in the mouth of the tube



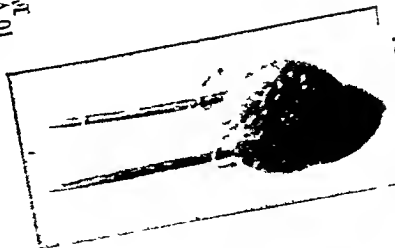
Cases of Double-Pointed Objects in the Bronchi, Esophagus and Stomach Removed by the Oral Route—Continued

Case Number and Illustration	Age and Sex	Foreign Body	Location and Sojourn	Ancesthetic	Tube	Problem	Forceps	Point of Seizure	Result	Time	Comment
	49 yr F	Burr of entangled and fastened hairpins	Stomach for 2 weeks	None	10 mm by 53 cm gastro scope	Bristling points dangerous to remove en masse the burr unfastened and disentangled with forceps and the mouth of the gastroscopic tube in the stomach, then withdrawn through the gastroscope	Rotation	Bights	Extraction, cure	Estimated 8 min	
	5 mo M	Wire bassinet fastener	Esophagus for 23 days	None	Esophageal speculum	Two points penetrated, with one resisting upward and the other, downward movement	Laryngeal grasping	Shaft of upwardly directed portion of the wire after disengagement the point was rotated so that the axis of this portion corresponded to the long axis of the esophagus, the latter was then pushed down ward so as to sheathe the point	Extraction, cure	2 min 22 sec	This foreign body particularly dangerous for traction, and complicated the necessity for the rule never to pull up on a pointed foreign body without sheathing the point, massive subcutaneous emphysema on admission from injudicious traction before admission

Fbdy 1943

Fbdy 2503

10 yr



Fbdy 2591

19 yr



Fbdy 2593

Double pointed pin bottom of an aphidstery of the lower lobe for 17 days

Bronchus of the right lung with the head in the bronchus of the lower lobe for 17 days

None

6 mm by 10 cm broncho scope

One branch perforated the bronchial wall, the subcutaneous bronchus too small to permit pushing downward

Approximation

By both points

Extraction, cure

9 min 11 sec

Approximation of the pointed branches relatively easy if not for one point completely buried in the bronchial wall, release of buried branch not possible by pushing downward but by rotation, potentially a dangerous case

10 min 7 sec

Extraction, cure

Forward by one end

A line where in a mass of pathological tissue, where a fibrous from connection

8 mm by 15 cm broncho scope

None

Bronchus of the lower lobe of the right lung for about 11 years

Unilateral

# EFFECT OF EXPERIMENTAL BILATERAL TURBINECTOMY ON THE DEVELOPMENT OF THE TESTES IN THE RABBIT

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ST LOUIS

The reports of various investigators working in both the clinic and the laboratory have definitely established the fact that the nose and related structures bear a significant relationship to the body as a whole. It has been determined in the laboratory that the carbon dioxide-carrying capacity of the blood is greater in a patient who breathes through his nose than in one who breathes through a tracheotomy tube<sup>1</sup>. It was found that the passage of air through the nose stimulates the sensory endings of the fifth nerve, thereby reflexly stimulating the vagus nerve, which results in an increased expansion of the chest. If one side of the nose is blocked the same side of the chest does not expand as fully as the other side. In a person who breathes through the mouth the blood is not oxygenated as much as in one who breathes through the nose, and the carbon dioxide-combining power of the blood is lower. This is explained as being due to the elimination of the nasothoracic reflex<sup>2</sup>. It is of interest to note that Wenner has found that the injection of carbon dioxide into the maxillary sinus of a rabbit breathing through a tracheal cannula causes a greater stimulus to respiration than the injection of air<sup>3</sup>. Jung and Chavanne found that several months after castration adult dogs do not have as great a secretion of nasal mucus as before castration when 5 mg of pilocarpine hydrochloride is injected<sup>4</sup>.

Fliess<sup>5</sup> and others have reported the disappearance of the pains of dysmenorrhea on cocainization of certain areas of the nose. Recently Crossen<sup>6</sup> also reported success with this procedure in a small series of

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From the Department of Otolaryngology, Oscar Johnson Institute, Washington University

1 Kreewinsch, P. The Lactic Acid of the Blood in Experimental and Pathological Mouth Breathing, *Acta oto-laryng* **17** 48, 1932, The Alkali Reserve in Cases of Nasal Obstruction and in Hyperplasia of the Tonsils, *ibid* **14** 90, 1930

2 Sercer, A. Investigations on the Reflex Influences of the Nasal Cavity on the Lung on the Same Side, *Acta oto-laryng* **14** 82, 1930

3 Wenner, W F. Personal communication to the author

4 Jung, L, and Chavanne, F. Nasal Secretion Following Castration, *Oto-rhino-laryng internat* **18** 481, 1934

5 Fliess. *Zentralbl f Gynak* **31** 981, 1908

6 Crossen, H S, and Crossen, R S. Diseases of Women, ed 7, St Louis, C V Mosby Company, 1930

cases. Conditions such as impotence following resection of the lateral wall of the nose, relief of sterility following cure of a nasal disturbance and disappearance of secondary sexual characteristics after a bilateral pathologic process in the nose have been grouped in a report of Karpow<sup>7</sup> as disturbances in the genital zone caused by changes in the nose. In a second group he listed changes that have been found in the nose following changes in the genital organs. They were anosmia following removal of a uterine myoma, stuffy nose and sneezing in a patient who was cured after gynecological treatment and nasal hemorrhage following excitement of the sexual organs, for example in coitus or an operation on the urogenital system. In a third group he listed vicarious dysfunctions of the nose due to disturbances of the genital organs, such as periodic nasal bleeding with amenorrhea, vicarious nasal hemorrhage with marked development of the sex organs and lack of vicarious hemorrhages in castrated women. The aforementioned reports seem to indicate that the nose and related structures bear a significant relationship to the body as a whole.

The report of Karpow on the effect of bilateral maxillary turbinectomy on the development of the testes in the rabbit is as mysterious as it is interesting. He removed the turbinate on one side of a rabbit from 5 to 6 weeks old and ten days later removed the turbinate on the other side. His approach to the turbinate was by means of a dorsal slit made in the nose. In the control animals at the end of thirty-nine weeks the combined weight of the testes, which had descended in the usual time to the scrotum, was 2.3 Gm. In the experimental animals in which the testes did not descend, the combined weight was about 1.2 Gm. The internal organs did not show marked change. The body weight of the animals on which the operation was performed was less than the weight of control animals of similar age. The sexual organs of both the male and the female animals of the former group weighed less than those of the controls. No microscopic observations were reported.

#### TECHNIC AND OBSERVATIONS

In this work the experiment performed by Karpow was repeated. Female rabbits were not used because the ovary is well developed at birth. Normal male rabbits from 4 to 5 weeks old were operated on on one side under ether anesthesia. A dorsal slit was made and the nasofrontal bone was turned laterally. The maxillary turbinate was removed with a scalpel and the insertion was cauterized with an electric cautery. The bone was then replaced and the skin was sutured. In ten days the opposite side was treated in the same manner. Several rabbits were operated on without removal of the turbinates in order to determine if mere surgical procedure in the nasal region would have any effect. In the rabbits that

<sup>7</sup> Karpow, N. Zur Frage des Zusammenhangs der Nase mit der Sexualsphaere. *Monatschr. f. Ohrenh.* 63: 758, 1929.

were cauterized the mortality was so high that cauterization was dispensed with, and more rabbits survived. Weekly records of weight were kept, and autopsy was performed when the animals were 6 months of age.

In normal male rabbits, according to Dorn and Sugarman<sup>8</sup> there is a definite relationship between descent of the testes and spermatogenesis. The testes are abdominal organs until the rabbit is about 3 months of age. They then come down into the inguinal ring and descend into the scrotum in a migration period lasting from ten days to two weeks. Spermatogenesis is not fully developed until the testes reach the scrotum.

Of a series of seven male rabbits on which turbinectomy was performed and which survived to 6 months of age, five developed normally, and the testes descended to the scrotum in the usual manner. In two rabbits the testes did not descend. The average body weight at 6 months of age of the controls and of the normally developing rabbits on which turbinectomy was performed was between 2.5 and 3 Kg. The weight of the testes averaged about 5 Gm, and all the testes had a normal histologic structure, showing normal spermatogenesis. Of the two

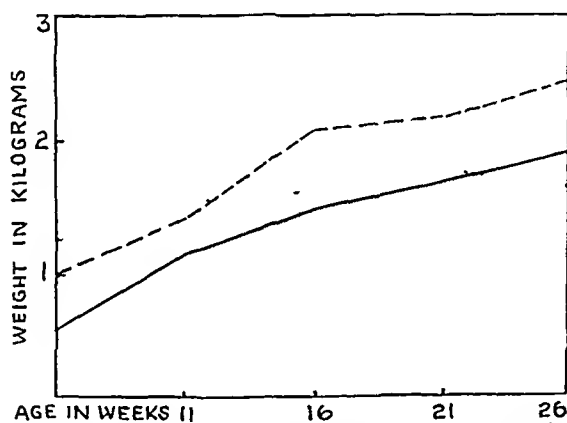


Fig 1—Weight of the experimental and control animals according to age. The line of dashes represents the control group, the solid line, the group on which turbinectomy with cautery was performed, and the line of dots, those on which turbinectomy alone was performed.

rabbits in which the testes failed to descend, the one in which cautery was used at the end of six months weighed 1.92 Kg, and the testes weighed 0.392 Gm. The other rabbit in which cautery was not used weighed 1.7 Kg (fig 1). The testes of this rabbit weighed 1.47 Gm.

No significant change in weight was found for the pituitary glands, for those for both the control and the experimental group averaged about 0.03 Gm in weight. No significant change was found in the internal organs other than the sex organs. The noses of the animals on which turbinectomy was performed showed a lack of the usual development, there being only a narrow slit on each side just adequate for the passage of air. The animals operated on without removal of the turbinates, that is, those in which a dummy operation was performed, developed similarly to the control animals. This would indicate that mere surgical procedure in the nasal region has no specific effect.

<sup>8</sup> Dorn, J. H., and Sugarman, E. I. A Method for the Prediction of Sex in the Unborn, *J. A. M. A.* 99:1659 (Nov 12) 1932.

The histologic observations on the testes which did not descend proved to be of great interest. Figure 2 shows a section from a testis of a rabbit on which turbinectomy was performed with cautery. It can be seen that spermatogenesis did not go beyond the spermatocyte stage, at which time degenerative changes took place. Many pyknotic nuclei can be seen.

Microscopic studies were made of the pituitary glands, but so-called castration cells were not found. These are large peculiar clear cells found in the anterior lobe of the pituitary gland and are derived from the basophil cells. Biedl<sup>9</sup> first described these cells in castrated albino rats. The literature is not in agreement generally on reported findings in the anterior lobe of the pituitary gland in other species. It is of interest to note that Biggart<sup>10</sup> reported vacuolation and colloid formation in the basophil cells in the anterior lobe of the pituitary gland of several persons who were castrated. The relation of the pituitary gland to descent of the

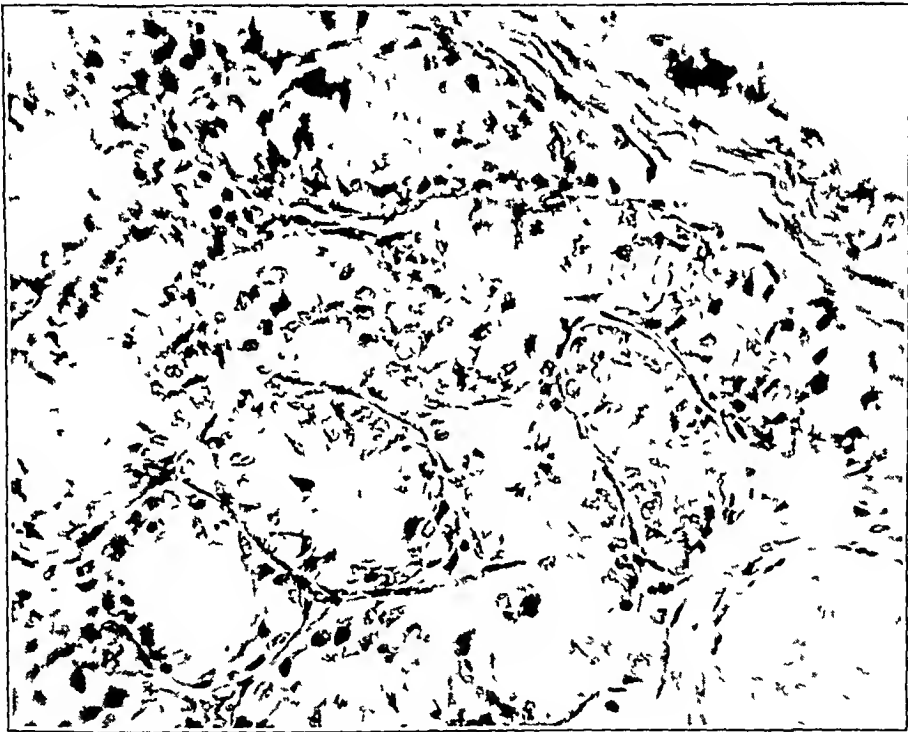


Fig 2—Photomicrograph of a section of the testis of a rabbit on which turbinectomy with cautery had been performed. There is no evidence of spermatogenesis beyond the spermatocyte stage. Pyknotic nuclei can be seen. Magnification,  $\times 900$ .

testes seems to be of great importance. Sexton<sup>11</sup> reported a series of cases of cryptorchidism in which descent of the testes to the scrotum followed the administration of an anterior pituitary-like hormone.

9 Biedl, A. Internal Secretory Organs, London, John Bale, Sons & Danielsson, Ltd, 1912.

10 Biggart, J. H. The Hypophysis of the Human Castrate, Bull. Johns Hopkins Hosp. **54** 157, 1934.

11 Sexton, D. L. Treatment of Sexual Under-Development in the Human Male with the Anterior Pituitary-Like Hormone of Urine of Pregnancy, Endocrinology **18** 47, 1934.

The failure of the descent of the testes, as can be seen, may be explained by both specific and nonspecific factors or by a combination of the two. An explanation of the results obtained is not feasible at this time and would go beyond the present knowledge and the scope of this investigation. It has been shown that removal of the turbinates interferes with the normal sexual development of some rabbits. The work confirms Karpow's report, and, in addition, histologic evidence is given. To determine the exact relationship of the nose and sexual organs will require the combined efforts of biologists, physiologists and biochemists. It is hoped that this report will demonstrate the possibilities of the relationship between the nose and the sexual organs and will stimulate further work in this field.

#### CONCLUSION

Removal of the maxillary turbinates of young rabbits will cause lack of development and spermatogenesis in the testes in some instances

# Clinical Notes

## DERMOID CYST OF THE TONSIL

MILTON M. ROSENBERG, M.D., SCRANTON, PA

Dermoids occur commonly and have been found in numerous localities in the body. The most frequent locations are about the orbit, neck and coccygeal region, where different germinal layers meet during development. Dermoids are also found in the subcutaneous tissue, ovaries, mediastinum, skull, pia mater, optic nerve, eyelid, cornea, face, nose, tongue and pharynx. Included in the foregoing list should be the rare sites. One of these is the mesentery (Montgomery and Morest<sup>1</sup> reported eight cases), and a second is the tonsil, where only three cases, including the present one, have been reported.

Henrot<sup>2</sup> in 1880 reported the removal of a tumor from the palatine arch but considered it to be a sebaceous cyst, though he realized that there are "no sebaceous glands in the mucosa of the palate under normal conditions." A histologic

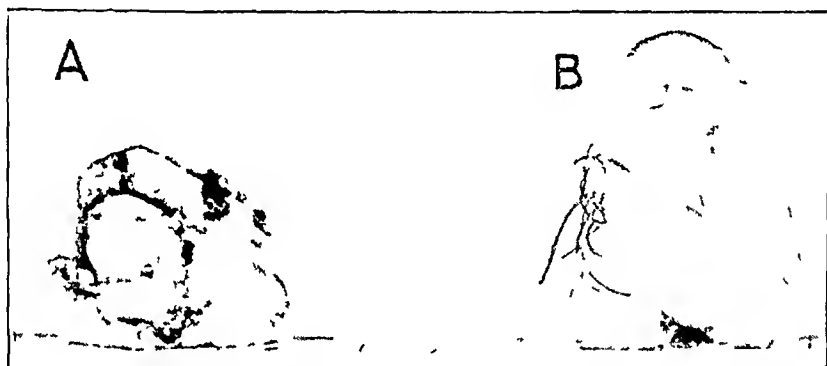


Fig. 1—A shows the left tonsil, and B, the cystic right tonsil with hair

report did not accompany the article. White<sup>3</sup> in 1881 removed a tumor from the palatal region of a child of 3 years, the tumor grew from behind the uvula. He thought the tumor had its origin in connection with the eustachian tube. Augier and Levrand<sup>4</sup> in 1903 reported a case of true dermoid of the tonsil in a child of 3½ months. The tumor was implanted in the supratonsillar lobe. The pathologic examination revealed the characteristics of a true dermoid cyst.

Riqueborg<sup>5</sup> in 1932 reported a similar tumor which arose from the right anterior pillar, but the question arises as to its being a sebaceous cyst, for on removal and incision of the membrane an abundance of "suet and debris of tissue which were recognized as epithelial concretions" was freed. Riqueborg's article included a reference to Jourdain (1778) in the *Journal de médecine*, but Jourdain's article refers to cases of ulcer, scrofula and syphilis. Riqueborg also quoted Dubosc,<sup>6</sup> i.e., his reference was to the thesis of Dubosc, who in turn quoted Parmentier,<sup>6</sup>

1 Montgomery, J. G., and Morest, F. S. *J. Missouri M. A.* **31** 456 (Dec) 1934

2 Henrot, A. *Union med. et sc. du nord-est* **4** 207, 1880

3 White, Hale. *Brit. M. J.* **1** 597, 1881

4 Augier and Levrand. *J. de sc. med. de Lille* **1** 457, 1903

5 Riqueborg, A. *Rev. Assoc. med. argent.* **45** 1493, 1932

6 Parmentier. *Gaz. de méd.* **2** 347, 1856



who reported cases of abscesses "These abscesses often appear without any very appreciable cause have been observed following extraction of a tooth or puncture of the palate by a fish bone"

#### REPORT OF A CASE

A L, an unmarried man aged 27, complained of difficulty in breathing through the nose, cough, difficulty in swallowing and vomiting. He was admitted to the outpatient department of the Scranton State Hospital in the department for



Fig 2—A section of the right tonsil, in the lower sixth of which hair follicles can be seen easily. Along the left border many sebaceous glands can be seen. In the central portion striped muscle is evident.

diseases of the nose and throat. The condition began three years before, when the patient felt fullness in the throat and difficulty in breathing on lying down. This was accompanied by cough, caused by tickling in the back of the throat. This continued to annoy the patient to such an extent that he looked into his mouth with a mirror and found a "lump" in the back of his throat.

About a month previous to the patient's admission to the outpatient department, while he was being examined for a position on the railroad, the mass was noticed, and as he complained of a cough a few hairs were removed from the mass, which lessened the cough. The mass was not removed.

General examination yielded negative results except in the throat. A mass was lying in the pharynx with numerous hairs protruding. The mass was attached to the tonsil (supratonsillar lobe) and not to the pharynx.

The patient was admitted to the hospital and the tonsils and the mass were enucleated under local anesthesia without much bleeding. The right tonsil was enucleated in three pieces.

Macroscopically the mass included the enlarged tonsil, which was approximately three times the size of the left tonsil and from which protruded long hairs, some of which were an inch (2.5 cm) in length. The mass of tissue measured 35 by

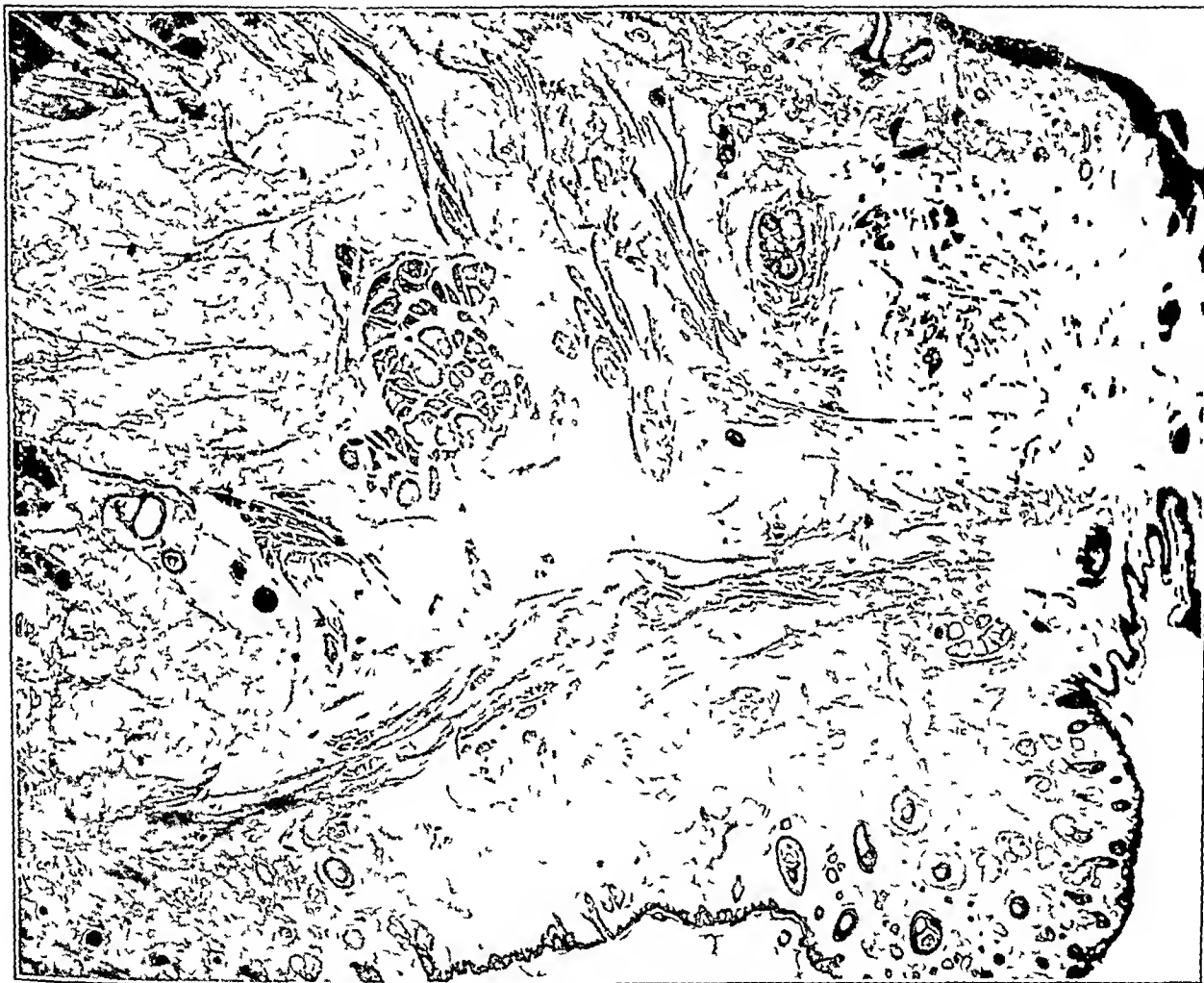


Fig 3—A section of the right tonsil, in the lower right corner of which the hair follicles show up distinctly. In the upper right corner glandlike structures can be seen.

25 mm and weighed 7.3 Gm. The surface was smooth, except for one area, which showed a growth of hair.

Microscopically a section of the right tonsil showed a considerable number of mucous glands. The epithelium was thickened and of the squamous type. It showed the presence of hair and sebaceous glands. The crypts in this area were ulcerated.

The diagnosis was dermoid of the right tonsil.

Examination of the patient four months later revealed a normal throat with no recurrence.

510 Medical Arts Building

## MODIFICATION OF THE JACKSON BRONCHOSCOPE TO PERMIT RETROGRADE INSPECTION OF THE BRONCHI OF THE UPPER LOBES

FERNAND VISTREICH, M D, NEW YORK

The importance of bronchoscopy for the removal of foreign bodies or the aspiration of secretions is well established, as is its recognition as a vital diagnostic procedure. The difficulty of thorough inspection of the bronchi of the upper lobes remains, however, a serious handicap.

The removal of foreign bodies or of anything which obeys the law of gravity rarely requires inspection of the bronchi of the upper lobes, however, internists and surgeons who are concerned with the diagnosis and treatment of pulmonary pathologic processes can ill afford to dispense with information about them. The bronchoscopist is therefore called on for a report on the entire tracheobronchial tree including the bronchi of the upper lobes, for they, as well as the bronchi of the middle and lower lobes, may be the site of malignant growth or of manifestations which might be of diagnostic significance.

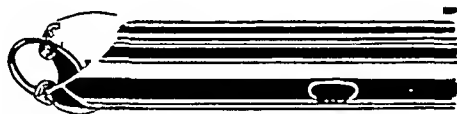


Fig 1—The distal end of the bronchoscope, showing the mirror in the middle position

There is known to me at present no device which solves the problem of retrovision of the bronchi of the upper lobes in bronchoscopy, although the need for such inspection is obvious and is too generally felt to require further elucidation. Inspired by this need I have modified the Jackson bronchoscope to permit retrovision from the tip of the instrument.

The modification consists of a small mirror fitted into the tip of the bronchoscope in such a manner that it can be brought into any angle desired and can be manipulated from the collar of the bronchoscope. The tip of the tube is cut so as to form not a lip, as in the ordinary bronchoscope, but a double V, with the apex of each V pointing distally. This is accomplished by cutting a V out of either side of the tube, with the bases of the V's meeting. Short arms attached to the apex of the V's hold the mirror in a side position and also act as an axis on which the mirror may rotate. A steel wire rod is hinged to one free edge of the mirror and is led through a canal in the tube to the collar of the bronchoscope, where it is connected with a screw in such a way that a turn of the screw moves the rod to or fro to change the inclination of the mirror. The mirror is sufficiently large to reflect the entire image of the bronchial opening of the upper lobe.

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From the Department of Surgery (Subdepartment of Otolaryngology) of the New York Hospital and Cornell Medical College

Neither the instrument nor its use is complicated. Its introduction is little different from that of the unmodified Jackson bronchoscope. The mirror may be kept parallel to the side of the tube or may be deflected to an angle in which there is no interference with vision but in which the reflecting surface is protected from the tracheal blast and flying mucus during the introduction. The bronchoscope should always be inserted through a Jackson laryngoscope in order

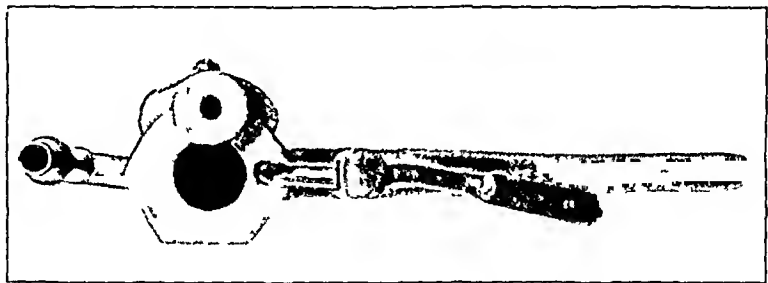


Fig 2—The proximal end of the bronchoscope, showing the mirror-regulating screw mounted on the collar

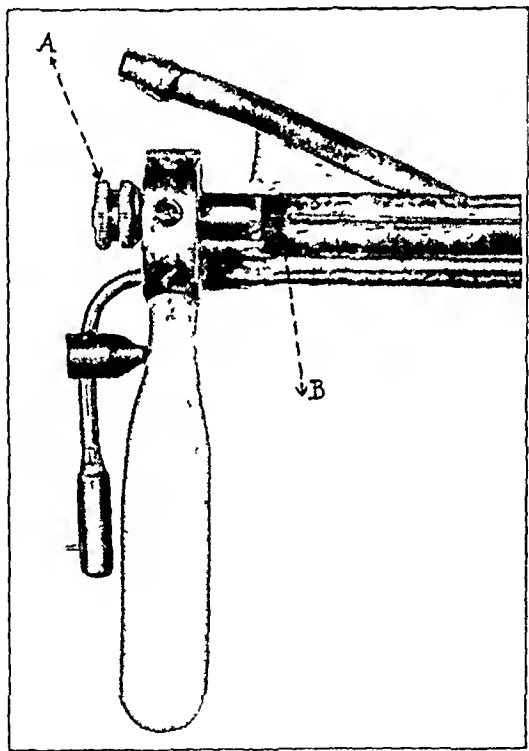


Fig 3—The proximal end of the bronchoscope, side view, showing (A) the mirror-regulating screw and (B) the rod as it enters the canal

to avoid soiling of the mirror in the pharynx and larynx. Clouding of the reflecting surface by respiration can be counteracted by warming the bronchoscope to slightly above body temperature before using, the temperature will be maintained by the warmth in the tracheobronchial tree during the examination.

Should the mirror become clouded or soiled during an examination—as no doubt it will in the presence of excessive moisture—the following procedure is suggested. The mirror is brought into rectangular position. A Jackson broncho-

scopic sponge, folded double, is moistened in alcohol and introduced through the bronchoscope, with it the surface of the mirror may be vigorously rubbed to remove the obstacle to vision. The moist sponge is replaced by a dry sponge and the mirror is again rubbed until dry. If the bronchoscope fills with discharge, suction must be used, followed by driving with sponges before the mirror is cleaned. The ordinary suction attachment with a blunt end and perforations only on the side will obviously be ineffective in cleaning the mirror. A suction tube with an open end is required for this purpose.

The cooperation of the patient is always necessary in bronchoscopic examinations. If the importance of keeping the mirror clean is explained to him he will use all his will-power to control his cough in order to facilitate the procedure.

The bronchoscopist can best train his eye for this new procedure by practicing on a calf's or a good-sized lamb's lung. He will discover the optimal degree of inclination of the mirror which brings the entire bronchial lumen into view and will become oriented in this field. It is useful to make mirror object-image sketches with the mirror at various inclinations. If I may use the phrase. He must make himself mirror-minded for ready orientation.

Instead of being boiled the bronchoscope must be sterilized in alcohol on account of the mirror. It must be carefully cleaned and dried and occasionally oiled before it is put away.

The instrument was made by Pfau's American Instrument Company, New York  
106 East Eighth-Fifth Street

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## AFTER-CARE OF PATIENTS FOLLOWING RADICAL MASTOID OPERATION

ALFRED LEWY, M.D., CHICAGO

Successful after-care of patients following radical mastoid operation presupposes a meticulously carried out bone dissection, with the roof straight out from the tegmen tympani and antri, no overhanging or otherwise obstructing bone, a mastoid cavity merging smoothly into the inner wall of the antrum, and a sloping floor with sufficient removal of the tip to have the same slope include it and the floor of the external canal. The facial ridge also should slope smoothly from the external (horizontal) canal and flatten into the slope of the floor. My own practice is to do nothing to the eustachian tube unless there is obvious necrosis, and to cleanse the tympanic cavity merely by wiping. If the curet is used it is only to lift out gently whatever debris may remain. As to the plastic operation, I prefer what is practically the Bondy, which is merely a splitting of the posterior part of the soft tissues of the canal, with no cutting into the concha except when this is necessitated by an unusually large cavity, in which event the flap must be suited to the cavity. The flaps are packed, without suturing, with petrolatum bismuth tribromphenate gauze, which is removed from the fifth to the seventh day. Treatment with powder is instituted without packing. The powder used is 1 part arsenic trioxide ( $As_2O_3$ ) in 5,000 parts of impalpable boric acid powder. The arsenic trioxide must be added first to a small amount, say 1 part of arsenic trioxide to 100 parts of boric acid powder and thoroughly triturated for a couple of hours, this is then added to the balance of the boric acid powder and further well triturated. The arsenic trioxide is used as an epithelial stimulant, but if any

amount of it should be concentrated in the mass it would be a powerful destructive agent as witness its use in skin cancers. I have used this powder for the past five years and believe it to be superior in result to the iodized boric acid powder or any other with which I have had experience. However its use does not do away entirely with the occasional necessity of using the chemical cautery or mechanically removing granulations so more recently I have adopted the so-called salt and pepper skin graft.

This type of graft was first used, I believe, by Dr C V Russell<sup>1</sup> of Lansing Mich., who used a sandpaper cylinder drawn across the skin of the patient's forearm the filings being allowed to drop on the surface to be grafted.

The salt and pepper graft is not new, but so far as I know its use in the mastoid cavity following a radical operation is, and I shall therefore describe the technic in detail. The cavity is carefully cleansed and dried, no antiseptics being used except perhaps hydrogen dioxide. One of the hands of the patient is scrubbed with a sterile brush and green soap and carefully dried on a sterile towel in which it is left wrapped for better drying until ready for use. No antiseptic, not even alcohol, is used. With a small rasp such as is used for removing calluses tiny particles of skin are filed off on a small piece of sterile paper previously grooved by folding. The drier the skin the more easily it is filed off. When 0.25 to 0.5 cc of particles of skin accumulate the accumulation is transferred by being allowed to slide down the groove in the paper into the mastoid cavity, assisted if necessary by a little draft of air from a Politzer bag. There is placed in the cavity a piece of petrolatum-smeared gauze, which is left three days. In some cases the mastoid cavity has shown an increased discharge which is followed by prompt healing and epithelization, in other cases it has healed without the increased discharge but in all cases surprisingly fast and well. The grafting technic is used as soon as the cavity shows healthy granulations about the end of the second or third week. There is a question in my mind whether or not there is an actual "taking" of the particles of skin in the sense of a graft, but certainly by some action the particles promote epithelization much more promptly than anything I have seen heretofore and the technic is so simple that it commends itself for practical application.

The treatment with powder is usually begun about the end of the second week, and that with epithelial particles about the end of the third week.

25 East Washington Street

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<sup>1</sup> Russell C V. New Method of Skin Grafting. J. Michigan M. Soc. **31**, 804 (Dec.) 1932.

# Progress in Otolaryngology

## Summaries of the Bibliographic Material Available in the Field of Otolaryngology

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### ALLERGY AS RELATED TO OTOLARYNGOLOGY

W W DUKE, M D

KANSAS CITY, MO

This year's literature is characterized by interesting advances in knowledge of the pathogenesis and pathology of allergy, new advances in knowledge of the etiology and pathogenesis of eczema and improvements in methods of treatment

#### PATHOGENESIS OF ALLERGY

It is difficult in an article of this scope to take up the theoretical intricacies of the interesting advances which are being made in the study of the pathogenesis of allergy. For this the reader is referred to the presidential address presented before the Association for the Study of Allergy by F M Rackemann.<sup>1</sup> His experiments, showing that frequently repeated intradermal injections of foreign protein into the skin of animals or human beings sensitize first in a way which gives a red tuberculin type of cutaneous reaction and later in a way which gives rise to a typical urticarial reaction, were reported in the 1934 review in the ARCHIVES.<sup>2</sup> Subsequent studies of tuberculous animals and human beings with this same technic by Dienes,<sup>3</sup> Simon<sup>4</sup> and Simon and Rackemann<sup>5</sup> showed that the changes in type of response to foreign proteins is much more rapid, in fact, it occurs after two or three inoculations under the influence of an infection. The first change

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1 Rackemann, F M. A Review of the Phases of Allergy, *J Allergy* **6** 17, 1934

2 Duke, W W. Allergy as Related to Otolaryngology, *Arch Otolaryng* **20** 712 (Nov) 1934

3 Dienes, L. The Immunological Significance of the Tuberculous Tissue, *J Immunol* **15** 141, 1928, Factors Conditioning the Development of the Tuberculin Type of Hypersensitivity, *ibid* **23** 11, 1932

4 Simon, Frank A. The Development of Hypersensitiveness, unpublished experiments

5 Simon, Frank A. and Rackemann, Francis M. The Development of Hypersensitiveness in Man. I Following Intradermal Injection of the Antigen, *J Allergy* **5** 439, 1934

causes a tuberculin type of reaction to foreign protein which often rapidly ends in necrosis. The second change which occurs after a few more inoculations causes in both animals and patients the appearance of a typical urticarial lesion at the site of inoculation. The importance of this work cannot be overemphasized since it tends to show that a person who has an infectious disease will respond more quickly to the effect of a parenterally introduced protein than will a normal person and that such a protein may render him allergic much more rapidly than it does the normal person. In other words it may be assumed that an infectious disease increases the individual susceptibility to sensitization to foreign matter.

The relationship which is believed to exist between infections of the respiratory tract and allergy can be recalled by referring to papers by Cohen and Rudolph<sup>6</sup> and by Waldbott and Snell.<sup>7</sup> Both mention the fact that an allergic condition in the nasorespiratory tract may be complicated by infection and that an infection can be easily imposed on allergic tissue. These papers illustrate in substance the fact that what is commonly called a recurring cold or bronchitis is frequently allergy and that this can be easily diagnosed through personal history, family history and examination, both clinical and cytologic. They emphasize the importance of recognizing the allergic basis for infections of the respiratory tract and the fact that successful treatment depends on recognition of the allergic factor. Allergic coryza, bronchitis and asthma bear little resemblance to the same conditions caused by infection. It is not necessary, I am sure, to repeat the many points in the differential diagnosis between infections and allergy which have been mentioned so often in these reviews. However it may be well to emphasize again the urgent need for the use of these diagnostic methods in cases of recurring coryza and bronchitis both in adults and in children since successful therapy, either medical or surgical, depends on a correct diagnosis.

#### PATHOLOGY OF ALLERGY

For the most recent developments in knowledge of the pathology of allergy the reader is referred to papers by Cohen and his associates and by B. S. Kline and A. M. Young.<sup>8</sup> These observers make a distinction between what they call reversible and irreversible allergic inflammations.

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6 Cohen, Milton B., and Rudolph, Jack A. Allergic and Infectious Conditions of Upper Respiratory Tract in Children. *Differential Diagnosis*, J. A. M. A. 97:980 (Oct. 3) 1931.

7 Waldbott, George L. and Snell, A. D. Pulmonary Lesions Resembling Pneumonia as the Result of Allergic Shock. *J. Pediat.* 6:229 1935.

8 Kline, B. S. and Young, A. M. Normergic and Allergic Inflammation. *J. Allergy* 6:247, 1935. Cases of Reversible and Irreversible Allergic Inflammation. *ibid.* 6:258 1935.



The reversible reactions, that is, those which disappear without leaving morphologic evidence of residual injury, are characterized by edema and eosinophilic infiltration, whereas the irreversible reactions, such as those which occur in tuberculous inflammations are characterized, if severe enough, by necrosis. Residual changes in structure are then permanent. Since it is impossible to reproduce the beautiful illustrations shown in these articles and almost impossible to review the subject adequately without them those who are interested are referred to the original sources for further information.

#### NEW ETIOLOGIC FACTORS

G. H. and E. C. Fonde<sup>9</sup> contribute a discovery to the subject of allergens in finding that "honey-dew" excreted in the form of numerous fine droplets by foliage insects can cause asthma. They state that in the South these droplets occur in such quantities at times that they can be observed in abundance on the windshields of automobiles and on glass slides placed under the trees. The saplike material appears under the microscope as small globules of resin-like substance. Sap gathered from the juicy bark of the trees presents similar globules. The Fondes state that the foliage pest inserts its sharp proboscis into the stomas of the leaves and sucks out the sap. Ants which climb the trees obtain the honey-dew from the foliage pests. "The tremendous industry on the part of the ants therefore would reasonably offer the source of an abundant escape of the practically pure live oak sap, which would allow droplets in the air under the trees." The authors observed a shower of honey-dew droplets on Christmas Day in 1933 after an outbreak of hay fever had occurred.

They state that they had failed to secure satisfactory relief from treatment in a certain number of patients whom they thought were sensitive to oak pollen and noted that attacks of asthma would come sharply and in advance of pollination of the oaks. They observed also that in persons supposedly sensitive to oak pollen cutaneous tests with oak pollen were not as frankly positive as was expected. These patients were then tested with an extract from the leaf and bark of the trees and gave more strongly positive reactions than with pollen but not as strong as when tests were made with honey-dew droplets obtained from an automobile windshield. The most potent extracts from the tree were obtained from the bark between the rough knuckles in the trunk. Treatment with the extract gave prompt relief to a patient who showed an intensely positive cutaneous reaction to oak sap. In this patient pollen therapy had been unsuccessful.

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9 Fonde, G. H., and Fonde, E. C. "Honey Dew" from the Live Oak a Cause of Hay Fever and Asthma, *J. Allergy* 6:288, 1935.

Duke<sup>10</sup> reports a study of four consecutive cases of asthma occurring among millers of wheat flour in which the illness was traced to the dust from the first cleaning of the wheat grain. In this dust the most conspicuous formed element (about 50 per cent by volume of the dust) consists of very fine, sharp-pointed wheat hairs. He believes that these hairs are an important factor in the causation of sensitiveness not only because they are able to penetrate and traumatize the bronchial membrane and possibly sensitize it to material intrinsic to the hair or attached to it, but also because of the fact that when wheat hairs are once lodged in the delicate mucosa of the respiratory tract they act as a foreign body and cause a foreign body inflammation in the tissues in addition to the sensitization phenomena. The asthmatic millers reacted violently to tests with extracts of the wheat hairs and gave much less severe or negative reactions to other fractions of the wheat grain.

Zitzke,<sup>11</sup> in studying the cause of eczema in 140 bakers, compared tests made with untreated flour and flour to which certain chemicals were added which are used in the preparation of flour for cooking. Sixty-seven per cent gave positive reactions to flour mixed with chemicals, in contrast to 41 per cent who gave positive reactions to untreated flour.

Harkavy and Romanoff<sup>12</sup> report positive cutaneous reactions to tobacco in 78 per cent of 69 cases of thrombo-angitis obliterans. Only 9 per cent of the patients reacted to ragweed or timothy. They obtained positive reactions to tobacco in only 38 per cent of 200 unselected cases of men and women smokers. They conclude from their studies that tobacco is the dominating reacting allergen in cases of thrombo-angitis obliterans.

Chobot<sup>13</sup> reports that in a study of 53 unselected patients in a clinic for children with asthma 19 gave slight reactions to tobacco extract, 22, moderate reactions, and 6, marked reactions. In 4 who gave the most marked reactions passive transfer could not be demonstrated. This differed from the studies of Harkavy and his associates, who demonstrated passive transfer in 13 cases. On account of the frequency of the finding of positive cutaneous reactions to tobacco in children, Chobot concludes that great caution should be used in interpreting a positive reaction as being of diagnostic value. He believes that positive reactions may be analogous to what is observed in testing cutaneously with wheal-producing solutions, such as morphine and histamine.

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10 Duke, William Waddell. Wheat Hairs and Dust as a Common Cause of Asthma Among Workers in Wheat Flour Mills, *J A M A* **105** 957 (Sept 21) 1935.

11 Zitzke, Erna. Cause of Baker's Eczema, *J Indust Hyg* **16** 218 1934.

12 Harkavy, Joseph, and Romanoff, Alfred. Skin Reactions to Tobacco and Other Allergens in Normal Men and Women Smokers, *J Allergy* **6** 62, 1934.

13 Chobot, Robert. The Significance of Tobacco Reactions in Allergic Children, *J Allergy* **6** 383, 1935.

Simon<sup>14</sup> reports the study of a patient who was sensitive to the serum from mammals of many types but who was insensitive to the extract of raw muscle of chicken, mackerel and codfish and to the serum of frogs and human beings. Sensitiveness to the mammalian serum could be transferred passively to normal skins and could be desensitized by mammalian serum. Certain experiments are presented to show that the antigenic factor is a protein.

Interest in drug idiosyncrasies as factors in the etiology of both allergic diseases and diseases which have not as yet been placed in the category of allergy is increasing with great rapidity. Squier and Madison<sup>15</sup> review the literature and report on a series of 19 patients who had acute primary granulocytopenia attributed directly to the use of amidopyrine. They refer to 52 additional cases observed by other physicians. In 2 of their patients who recovered from the disease following discontinuance of amidopyrine the administration of one dose was followed by a rapid fall in the granulocyte count. The patients who recovered from the acute disease and avoided the drug had no recurrence of the illness. Cutaneous sensitivity was reported in 2 patients with systemic reactions, fever and reduction in the granulocyte count following the application of a 10 per cent solution of amidopyrine to the unabrased skin.

Sulzberger and Simon,<sup>16</sup> after a study of induced sensitization to arsphenamine in guinea-pigs, conclude that these animals can be sensitized to neoarsphenamine experimentally by intradermal injection and that this sensitiveness is specific for the arsphenamine complex. It does not induce sensitiveness to any other pentavalent or trivalent organic or inorganic arsenical and cannot be identified with sensitiveness to the element arsenic. They state that these findings correspond with those observed clinically in persons who are sensitive to arsphenamine.

Sulzberger,<sup>17</sup> in suggesting a classification for certain dermatoses, makes a distinction between reactions in the cutis, which appear after a period of hours or days in the form of eczema, and reactions in the subcuticular tissues, which appear promptly in the form of a wheal. He thinks that the former type of reaction is caused by substances which on contact can pass through the horny layer and the oily, sebaceous covering of the skin. Substances which are able to make this penetration he assumes to be those which can destroy, penetrate or mix with the

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14 Simon, Frank A. A Species Nonspecific Antigenic Factor in Mammalian Serums, *J Allergy* 6 1, 1934

15 Squier, Theodore L, and Madison, Frederick W. Primary Granulocytopenia Due to Hypersensitivity to Amidopyrine, *J Allergy* 6 9, 1934

16 Sulzberger, Marion B, and Simon, Frank A. Arsphenamine Hypersensitivity in Guinea Pigs, *J Allergy* 6 39, 1934

17 Sulzberger, Marion B. A Suggestion for the Classification of Certain Allergic Dermatoses, *J Michigan M Soc* 34 78, 1935

fatty, horny covering, such agents for example as oils which can be dissolved in the fatty substances of the epidermis, eczema-producing fungi, certain dyes and certain metals and local anesthetics, such as procaine and butesin, which have an affinity for ectodermal structures. He refers to a paper by Bughard on patients sensitive to alkalis who were found to have skins which were not so capable of neutralizing alkaline solutions as those of normal persons. He believes that the subcuticular reactions are caused by water-soluble substances which are unable to reach sensitive tissues through the normal unabraded skin. For a reaction of this sort the foreign substance must reach the sensitive tissue through traumatized skin or through the medium of the blood stream from distant points.

#### TREATMENT

Brown<sup>18</sup> reports further studies on maximum dosage in pollen therapy and states that after three years of added experience he draws the same conclusions that he did previously and that this speaks well for the effectiveness of the method. He states, as formerly, that results obtained in the treatment of hay fever and asthma due to pollen are directly proportional to the size of the maximum dose reached before the pollination season begins and that by gradually increasing the pre-seasonal dose to a maximum of from 100,000 to 200,000 pollen units failures are eliminated in therapy of hay fever and perfect results are practically assured. To reach this dosage he gives from 1 to 2 cc of 10 per cent pollen extract. He says that this may be done with perfect safety and comfort provided care and judgment are used in regulating the preliminary increases in dose for each patient. He adds that with this method of therapy complete and permanent desensitization can be obtained with a disappearance of the positive cutaneous reactions.

Thiberge,<sup>19</sup> in making a study of nonspecific therapy in the treatment of asthma, compared the effect of histamine and typhoid split protein in the treatment of patients who had not responded well to specific treatment. He concludes that typhoid split protein and histamine are both useful in the treatment of allergy, whether respiratory, cutaneous, digestive or bacterial. He believes that typhoid protein is safer than histamine although not so rapidly effective. He also prefers the intradermal method of therapy. He states that injections of histamine often precipitate asthma, which can be controlled with epinephrine, and suggests that unusual care be maintained in the treatment of elderly persons.

18 Brown, Grafton Tyler. Further Experiences with Maximum Dosage Pollen Therapy, *J. Allergy* 6:86, 1934.

19 Thiberge, Narcisse F. Histamine and Typhoid Protein Compared in the Control of Asthma and Hay Fever, *J. Allergy* 6:282, 1935.

Cohen and Rudolph<sup>20</sup> report that extract of adrenal cortex used in the treatment of 4 selected patients with asthma failed to reduce the severity of the illness. The extract was given in doses which had relieved other patients who had Addison's disease and for that reason were considered to be adequate amounts for an asthmatic patient if the illness was due to insufficiency of the adrenal cortex. My experience with extract of adrenal cortex has been similar to that of Cohen and Rudolph.

Graeser and Rowe<sup>21</sup> report results obtained in 40 asthmatic patients treated symptomatically by the inhalation of a 1:100 solution of epinephrine nebulized with a glass atomizer. They state that good symptomatic results were thus obtained and that the method is easier for the patient to learn and use than the subcutaneous method of administration. Disagreeable constitutional effects were not observed.

#### IONIZATION

Several writers report favorable results obtained by ionization in the fall of 1934, but none of the results can be considered to be typical because during that drouth year the pollen content of the air was the lowest it has been since pollen counts have been recorded annually. I may say in passing that as much pollen was deposited on a greased slide in Kansas City, Mo., in one day in the fall of 1935 (September 15) as would have been deposited during the entire ragweed season in 1934.

H. L. and J. H. Alexander,<sup>22</sup> who have investigated ionization through work made possible by a gift secured from an anonymous donor, state that the mechanism by which a slough is formed in the nose after ionization was not investigated, although it seemed plausible to them that ionization is merely an effective form of cautery. They say that if this assumption is true, relief following ionization may be attributed to a mechanical removal of the antibodies from the nasal membrane. The restored mucous membrane is not sensitive, so inhaled or ingested allergens evoke no response. The authors attempted by means of ionization to determine how soon the newly formed epithelial tissue would become sensitive. They surmised that if the reagin content of the blood persisted sensitization would return as soon as the new nasal tissues absorbed antibodies from the blood. On the other

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20 Cohen, Milton B., and Rudolph, J. A. Studies on the Relation of the Adrenal Glands to Allergic Phenomena. III. On the Specific Therapeutic Effects of Cortical Adrenal Extract in Asthma, *J. Allergy* 6: 279, 1935.

21 Graeser, James B., and Rowe, Albert H. Inhalation of Epinephrine for the Relief of Asthmatic Symptoms, *J. Allergy* 6: 415, 1935.

22 Alexander, H. L., and Alexander, J. H. Ionization of the Nasal Mucosa. Relationship Between Reagins in the Blood and Effect of Treatment, *J. Allergy* 6: 240, 1935.

hand, if no reagin could be demonstrated in the blood the process of localization of new antibodies in the nasal membrane should be slower. These possibilities were the only ones investigated in their research.

In the cases reported the history of allergy was taken in the routine way and careful local examinations were made. This included a study of the nasal secretions and the noting of the relative number of eosinophils. Intradermal tests were made, and positive reactions were measured with a planimeter and recorded in square centimeters. Only decidedly positive reactions were recorded. Reagins were sought for by the usual technic of passive transfer of blood serum to normal skin. Counts were made of the eosinophils in the blood. The nose was then ionized, and the patient was reexamined at the end of two weeks and after three months. In some cases topical application of allergens which had caused trouble were made to the nasal mucous membrane before and after treatment.

The authors state that the series of cases studied was small and is reported on only in answer to the many queries concerning the rationale of therapy by ionization.

Fifty-three patients received treatment by ionization. Twenty-three were reexamined at the end of two weeks but failed to return at the end of three months. Five others were examined after two weeks but the period of three months has not yet expired. The results of treatment obtained in 25 cases are tabulated.

As a result of ionization the size of the initial cutaneous reaction did not change materially. The size of the reactions to passive transfer tests was somewhat variable, but this was attributed to the fact that it was not always possible to repeat passive transfer tests on the same persons. Eosinophilia was not particularly altered. Eosinophils persisted in the nasal secretions even of the patients who were relieved. Topical applications of the allergens produced a variable and inconsistent response. Seven of the 9 patients who did not secure any relief showed demonstrable reagins in the blood. Reagins were found in only 3 of a group of 11 who were relieved. The authors give as their preliminary conclusion from the results at hand that if patients have no reagins in the blood the chance of relief by ionization is greater.

## News and Comment

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### AMERICAN BOARD OF OTOLARYNGOLOGY

An examination was held in Cincinnati on Sept 14, 1935. Fifty-seven candidates were examined, of whom forty-two were certified and fifteen conditioned.

The Board will hold an examination in Kansas City, Mo., on May 9, 1936, during the meeting of the American Medical Association, and one in New York in October 1936 just prior to the meeting of the American Academy of Ophthalmology and Otolaryngology. The exact date of the latter has not yet been set. Prospective applicants for certificate should address the secretary, Dr W P Wherry, 1500 Medical Arts Building, Omaha, for application blanks.

# Abstracts from Current Literature

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## Ear

OTITIC HYDROCEPHALUS HUGH G GARLAND, Lancet 2 751 (Sept 30) 1933

The intracranial complications of otitis media comprise many clinical and pathologic conditions, among them is a well defined syndrome for which the name "otitic hydrocephalus" was suggested by Symonds in 1931. This syndrome can usually be diagnosed on the basis of clinical manifestations, and it responds rather dramatically at times to simple therapeutic measures. The clinical manifestations of otitic hydrocephalus are: Its occurrence is confined almost entirely to children and young adults, complicating either acute or chronic otitis media, headache is frequent and may be either severe or slight, papilledema is constant, although vomiting and nausea are variable, the mental reaction is usually undisturbed, but dulness has been present in a few instances in which there has been a high grade of papilledema, the cerebrospinal fluid is under high pressure and of large volume but is normal chemically and bacteriologically. The condition usually clears up after weeks or months as a result of repeated lumbar puncture. If this procedure is not frequently carried out optic atrophy may ensue.

BECK, Buffalo [ARCH NEUROL & PSYCHIAT]

CASES OF AURAL VERTIGO AMENABLE TO TREATMENT BY OSSICULECTOMY JAMES DUNDAS-GRANT, Lancet 2 1029 (Nov 4) 1933

According to Dundas-Grant, certain cases of aural vertigo are suitable for ossiclectomy. Vertigo, either constant or in attacks, headache, convulsions and loss or diminution of hearing acuity were among the symptoms which the patients presented. In all cases one or both of two conditions were present. Either the ossicles obstructed the outlet of the attic and so prevented the escape of thickened discharges or the ossicles were fixed, leading to an immobility of the otherwise mobile stapes. Thus, in the former condition, the removal of the ossicles permitted the free escape of the contents of the attic with relief from headache and vertigo and to some extent from dulness of hearing. In the latter condition, the restored mobility of the stapes provided the normal safety-valve for variations of intralabyrinthine tension, with disappearance of the vertigo. Ten of the patients who were operated on were entirely cured, and the other two were much relieved of their symptoms.

BECK, Buffalo [ARCH NEUROL & PSYCHIAT]

FACIAL PARALYSIS AND LABYRINTHITIS ANATOMIC EXAMINATION OF THE FACIAL NERVE ANDRÉ THOMAS and L. GIRARD, Rev d'oto-neuro-ophth 11 664 (Nov) 1933

A patient entered the hospital on Dec 5, 1932, with facial paralysis of peripheral type on the right side and pain in the teeth and ear. In 1921, 1922 and 1929 she underwent several operations for osteomyelitis of the humerus. Three months before her admission to the hospital a vertiginous attack, with diminished hearing in the right ear, had occurred. Examination revealed a normal drum membrane, total deafness of the right ear, a few nystagmus twitches and almost total paralysis of the right facial nerve. No Romberg sign or spontaneous deviation was present. There were no signs of cerebellar disease. Lumbar puncture on December 8 revealed 696 polymorphonuclears per cubic millimeter. On December 9 the ear began to discharge and a positive Kernig sign and stiffness of the neck were observed. The spinal fluid contained 845 cells per cubic millimeter. Operation revealed a normal mastoid process but the tympanum was filled with pus which



came from a large extradural abscess by way of a fistula through the oval window. The labyrinth was opened. Drainage was inadequate, and the patient died in coma six days later. At autopsy the fistula was found to open on the endocranial surface slightly external to the fallopian hiatus, having passed above the elbow of the fallopian aqueduct and the seat of the geniculate ganglion. Serial sections of the facial nerve, including the geniculate ganglion and extending to the endocranial portion, showing the following changes: The connective tissue sheath was thickened and contained masses of nuclei, these masses were sparse in the geniculate ganglion, the pericapsular cells were not proliferated, the masses were composed of fibroblasts, plasmocytes and mononuclear and polymorphonuclear cells. The masses were numerous at the level of the passage of the petrous nerves into the facial nerve. The lesions situated in that portion of the nerve inside the ganglion and in the internal auditory meatus were the most intense. Foci of hemorrhage in the sheath and in the nerve itself, separating the fibers by pools of blood, were present. The nerve fibers were poorly stained, and the axis-cylinders were swollen, irregular and disaggregated. The neighboring arachnoid showed considerable proliferation of nuclei but relatively few polymorphonuclear cells. The assumption is that a benign otitis complicated by labyrinthitis occurred in September and that the process remained latent until the facial paralysis occurred. The hypothesis is suggested that staphylococci from the site of the osteomyelitis might have hibernated in the labyrinthine capsule where they remained until awakened to activity by some favorable circumstance. It is known that staphylococci have the ability to live a long time in osteomyelitic foci and to emigrate and that they have a predilection for osseous tissues when their primary seat has been in bone.

DEANIS, San Diego, Calif [ARCH NEUROL & PSYCHIAT]

EPILEPTIC CRISES CAUSED BY A JXTAMENINGEAL FOCUS OF INFECTION IN A PATIENT WITH OTOGENOUS CEREBRAL ABSCESS—OPERATED ON SEVERAL YEARS PREVIOUSLY. E. R. CASTELNAU, Rev. d'oto-neuro-opht **11** 680 (Nov) 1933

A man, aged 40, who had recovered ten months previously from an otogenous cerebral abscess on the left side, complained one evening of a sudden attack of headache, began to talk volubly and incoherently and saw double. After a quiet night, a typical epileptic attack occurred the next morning. Irritation from a small persistent focus of infection near the meninges was suspected. The old wound was reopened, a block of fibrous tissue corresponding to the meningeal cicatrix was loosened, and some granulations were removed from the former site of the mastoid antrum. Recovery was prompt. In two years there have been no more convulsive crises, and headaches have been rare. This condition must be distinguished from the vertiginous auricular epilepsy reported by Roger and Reboul-Lachaux. The appearance of epilepsy in the course of an infection of the mastoid suggests a cerebral complication. Cases like the one reported are rare. Only two have been reported.

DEANIS, San Diego, Calif [ARCH NEUROL & PSYCHIAT]

A GLYCERIN PREPARATION IN THE THERAPY OF THE EUSTACHIAN TUBE. P. J. MINK, Arch f. Ohren-, Nasen- u. Kehlkopf **139** 121 (Jan 24) 1935

Mink calls attention to the therapeutic action of a preparation which contains 5 per cent antipyrine and certain anesthetics in a glycerin that is entirely free from water. He administers it in the eustachian tube in cases of acute inflammation and catarrhs of the tympanic cavity. He says that it may be applied also in the auditory meatus, but that the tubal application alone is effective. He thinks that the withdrawal of water by the glycerin is the most important factor. He also employs the glycerin preparation in the treatment of chronic catarrhs of the eustachian tube. In these cases he is convinced that the anesthetic action of the remedy is of no significance, and that the dehydration by the glycerin is the most important factor.

EDITOR'S ABSTRACT

CHANGES IN TEMPORAL BONE IN PATIENTS WITH TUMOR OF ACOUSTIC NERVE  
H BRUNNER, *Monatschr f Ohrenh* **69** 177 (Feb) 1935

Brunner describes the changes he observed in two additional cases of tumor of the acoustic nerve. He gives a detailed description of the microscopic aspects of the temporal bones and reaches the conclusion that these cases differ greatly from the two cases he reported in the previous paper, for the dilatation of the internal meatus was absent in both cases, as was the severe atrophy of the nerve terminals in the internal ear. In a later report he hopes to explain the differences between the two groups of cases.

EDITOR'S ABSTRACT

THE CHOLESTEATOMA IN RELATION TO BLOOD CHOLESTEROL K A DRENNOWA,  
*Ztschr f Hals-, Nasen- u Ohrenh* **37** 212, 1935

Drennowa investigated (1) whether the cholesteatoma is the result of a disturbance in the cholesterol metabolism and (2) whether the cholesteatoma is the result of a local reaction of the tissues to chronic irritation. She reaches the following conclusions: 1 The cholesterol content of the blood is no indication of the presence of a cholesteatoma. 2 The cholesteatoma is not caused by a general disturbance in the cholesterol metabolism but is rather the result of a disorder of the local tissue metabolism. 3 The high incidence of the cholesteatoma in cases of epitympanitis (67 per cent of all cases) indicates that in this form of chronic otitis there exists an excess of lipoids together with a local disturbance of the cholesterol metabolism in the tissues of the middle ear. 4 Histologic examination of the granulations and polyps for the presence of lipoids discloses the presence of a large quantity of sudanophil cells in the cases which are especially severe as regards the clinical as well as the pathologic-anatomic aspects. 5 The destructive action of such sudanophil granulations and polyps justifies their classification with the cholesteatomas, and because of their clinical and pathologic-anatomic similarity to cholesteatomas they may be designed as "microcholesteatomas".

EDITOR'S ABSTRACT

## Larynx

ACUTE LARYNGOTRACHEITIS A CLEMENT SILVERMAN, *Arch Pediat* **51** 257  
(April) 1934

Attention is directed to obstructive inflammations of the larynx and in particular to the entity acute nondiphtheritic laryngotracheitis. All obstructive conditions of the larynx produce much the same picture and are most prevalent in children under 5 years of age during the winter season. Hoarseness, a barking cough, stridor, aphonia and later, with increasing obstruction, dyspnea and cyanosis are common symptoms and signs. Every patient with laryngeal obstruction of an inflammatory nature should be examined with the laryngoscope and the bacteriologic status of the inflammation determined, in order that proper therapeutic measures may be employed. It is not enough to administer diphtheria antitoxin on suspicion. The Schick test affords a valuable aid in rapid diagnosis of the etiology of the obstruction.

WADDLIE JR, University, Va [AM J DIS CHILD]

LARYNGEAL HEMIPARESIS FOLLOWING ADMINISTRATION OF ANTITETANIC SERUM  
HENRI ROGER and MAURICE BERLOND, *Rev neurol* **1** 453 (March) 1934

A patient with this condition showed typical urticaria and pains in the joints following the use of antitetanic serum as a prophylactic. Suddenly dysphonia appeared, which was shown by laryngoscopy to be due to paralysis of the right vocal cord, with involvement of the epiglottis. Since local causes of the lesion were ruled out, the authors consider this condition to be a neuritic complication of serotherapy.

DAFFIN, Boston [AM J DIS CHILD]

MECHANISM OF FALSE VOCAL CORDS IN RELATION TO RECURRENT NERVE ACT OF SWALLOWING A RETHI, *Monatsehr f Ohrenh* **69** 129 (Feb) 1935

This is one of a series of investigations in which Rethi studied the innervation of the larynx. He points out that the larynx is important in three respects as a respiratory organ, as a tone-forming organ and finally as a door of the deeper air passages, as which it must prevent the entrance of foreign bodies into the air passages. The latter function is especially important during the act of swallowing. In this report, he concerns himself with experiments which he carried out in order to determine the function of the larynx during the act of swallowing, giving his attention to the muscles and nerves by means of which the larynx performs its part during the act of swallowing. He made his tests on dogs. He agrees with Abderhalden, who maintained that swallowing is not a voluntary act. This may seem unusual when one considers that one is capable of swallowing at any time. However, one is able only to elicit, not execute, the act of swallowing. One produces a stimulus, usually by bringing saliva onto those portions of the mucosa that are under the influence of the superior laryngeal nerve. Here the reflex of swallowing is elicited, but the complicated mechanism of swallowing follows compulsory paths. If one attempts to swallow dry, the whole mechanism fails. Moreover, if the aforementioned portion of the mucous membrane is rendered insensitive, that is, if the center of swallowing is prevented from receiving a stimulus, swallowing does not take place. Rethi states that the results of his experiments corroborate this theory of Abderhalden's. He describes nine different experiments and shows a number of pictures that he took with a slow motion cinematograph. His experiments disclosed that swallowing is entirely normal only if all laryngeal nerves are unimpaired. However, even if both the recurrent nerves have been paralyzed, the glottis is completely closed and the laryngeal process of swallowing shows hardly any deviations from the normal function. If the internal branch of the superior laryngeal nerve is severed, but the recurrent nerve is left unimpaired no impairment of the act of swallowing is noticeable. However, if, on the same side, the internal branch as well as the recurrent nerve is severed, a considerable retardation of the paralyzed side is noticeable during swallowing. This indicates that the internal branch of the superior laryngeal nerve and the recurrent nerve are of equal importance in the laryngeal process of swallowing. He further shows that impairment of the transverse muscle is of great importance in the act of swallowing. He points out that the recurrent nerve sends an important branch into the transverse muscle that the superior laryngeal nerve has important branches in this muscle and that within this muscle there is an anastomosis between the inferior and superior laryngeal nerves. His studies revealed also what muscles play the most important rôle in the laryngeal act of swallowing. In dogs, they are the transverse muscle, the detrusor epiglottidis and the cricothyroid muscle, in human subjects, the obliquus muscle likewise plays a part.

EDITOR'S ABSTRACT

## Nose

URGENT TREATMENT OF ACUTE RETROBULBAR OPTIC NEURITIS OF SINUS ORIGIN PHENOLIZATION M TERRACOL, *Rev d'oto-neuro-opt* **12** 401 (June) 1934

Terracol reviews the subject of the treatment of acute retrobulbar optic neuritis and states that the confusion existing is due to the following factors. 1 Ocular disturbances are in the domain of pure ophthalmology, and yet they have been the subject of discussion by rhinologists. 2 The definite formula that retrobulbar optic neuritis is always due to infection in the sinuses and requires intervention on the sphenoid sinuses has been imposed. 3 The term retrobulbar optic neuritis was introduced by von Graefe to designate lesions more highly situated in the optic nerve than those which cause peripheral paralyses. Ophthalmologists themselves argue over the pathogenic and symptomatic substratum of retrobulbar optic neuritis.

The present tendency is no longer to regard neuritis as a special malady but under this term to include all diseases of the posterior segment of the optic nerve (between the chiasm and the point of penetration of the central vessels of the retina). Histologic studies do not show that the nerve structure is altered by the penetration of the retinal vessels. Hence, this subdivision of the nerve has only a topographic value. Not all patients with retrobulbar optic neuritis recover spontaneously, and in about 50 per cent of the cases the etiology is not discovered.

In collaboration with Canuyt, Terracol has conducted researches on retrobulbar neuritis for several years. The conclusions are that an infection of the posterior sinuses or the bacterial toxins can easily reach the optic nerve, the causal factors may be arranged in the following order: syphilis, infectious rhinosinusitis, disseminated sclerosis, heredity, intoxications and vasomotor disturbances. Syphilis is too often forgotten, but, on the other hand, systematic treatment in the face of the lack of all signs of syphilis is a fault, because each day the lesion progresses. Sinusitis does not always mean the formation of pus, there are various grades of inflammation. The etiology of sinusitis ought not to be disregarded, and intervention must often be early, all patients with optic neuritis should have a thorough rhinologic examination. Per contra, sinusitis alone must not be assumed. It is the duty of the rhinologist to furnish the ophthalmologist with as precise data as possible on the state of the sinuses. Special methods of examination are required: shrinking of the region with cocaine and epinephrine, catheterization and puncture of the sinuses and the taking of roentgenograms. The ophthalmologist must direct the treatment and determine the indications for operation. Trepanation of the sphenoid sinus is the most logical procedure, but it should be reserved for serious cases. When the condition is unilateral and evolves slowly, with signs often atypical, excellent results are obtained by phenolization. Under close control by the oculist, if the disease is not ameliorated, immediate operation on the sinuses is indicated.

DENNIS, San Diego, Calif [ARCH NEUROL & PSYCHIAT]

UNILATERAL BLINDNESS LATENT CLOSED EMPYEMA OF A POSTERIOR ETHMOID CELL RECOVERY FOLLOWING OPERATION L CERISE, J RAMADIER and H GUILLON, Rev d'oto-neuro-opt 12 499 (July-Aug) 1934

A man, aged 32, entered the hospital with the complaint of loss of vision in the left eye and periorbital pain for the previous eight days. Examination revealed a slightly swollen and edematous papilla and an enormous central scotoma in the left eye. Vision was limited to a narrow crescentic area with its concavity downward. There was no sign of nasal suppuration, and the roentgenographic examination showed no evidence of involvement of the sinuses. Since the vision rapidly diminished to complete blindness, resection of the septum and exploration of the posterior sinuses were done. Two cubic centimeters of thick fetid pus was evacuated from a posterior ethmoid cell. The operation was not extended farther. Improvement was immediate, and at the end of the eighth day the visual field and the papilla were normal, and vision was 9/10. From an ophthalmologic point of view, this case was one of optic neuritis with functional signs quite different from those of the classic form. The authors agree with Portmann and Pesme that the association of functional signs of retrobulbar neuritis with papillary lesions and painful symptoms suggests that these ocular disturbances originate from an infected sinus. In such cases even when the nasal examination gives negative results an early exploratory operation on the ethmoid and sphenoid sinuses is indicated.

DENNIS, Colorado Springs, Colo [ARCH NEUROL & PSYCHIAT]

STRUCTURE OF LOWER (NASAL) SECTION OF NASOLACRIMAL DUCT L A ZARITZKY, Monatschr f Ohrenh 69 166 (Feb) 1935

Zaritzky shows that opinions about the structure of the lower portion of the nasolacrimal duct are still divided. Some investigators maintain that there are valves at the lower end while others deny this. He studied the structure of the

nasolacrimal duct on the corpses of ten children and twenty-two adults. He found that the fibrous layer of the nasolacrimal duct consists of numerous connective tissue fibers with many closely adhering elastic fibers that run parallel to the longitudinal axis of the canal. In addition to the longitudinal fibers, there are also transverse and oblique fibers which fix the longitudinal fibers, so to speak. In some portions of the duct, particularly at its end, where some authors assume the valve to be, there are circular, usually elastic, fibers that form a sphincter and close the canal. Zaritzky was unable to detect a typical valve, but quite often he observed in its place a protrusion of the mucous membrane into the lumen of the canal, apparently as the result of an inward pressure of the circular fibers that are located there. In some specimens he observed near the connective tissue sphincter (two or three such sphincters were detected in the examined section of the duct) smooth muscle elements, which apparently increase the activity of these sphincters. The bundle of circular fibers is especially noticeable in persons over the age of 16 years. During early childhood, the accumulation of these fibers is much less noticeable. He thinks that this might be the reason that children are more subject to conjunctivitis of nasal origin. Moreover this applies also to persons with chronic atrophic rhinitis in whom, as the result of atrophic changes in the mucous membrane of the nasolacrimal duct and of a weakness of the circular fibers, the lumen of the duct gapes so that micro-organisms and nasal secretion may enter into the duct. Zaritzky states further that between the periosteum and the fibrous layer of the duct, particularly in its lower portion, there is a close venous net, which apparently is closely connected with the cavernous plexus of the nasal cavity. In young children the cavernous plexus is incompletely developed. He observed that in children the opening on the lower part of the nasolacrimal canal is ellipsoid or cleftlike, while in the aged the opening is usually triangular, probably because the contracting power of the circular fibers decreases with advancing age.

EDITOR'S ABSTRACT

SYMPTOM COMPLEX OF NASOCILIARY NERVE. I. ABRAMOWICZ and T. WASOWSKI,  
*Monatschr. f. Ohrenh.* 69 171 (Feb.) 1935

Abramowicz and Wasowski call attention to the syndrome of the nasociliary nerve, which was first described by Charlin in 1930. It consists of (1) inflammatory manifestations in the anterior portion of the eye, namely, conjunctivitis and inflammation of the cornea, iris and ciliary body, (2) a unilateral inflammation of the nasal mucous membrane with considerable hyperemia and swelling of the involved side and with hyperemia of the anterior portion of the lower nasal concha, and (3) neuritic pains in the eyeball, in the orbital cavity and in the frontal region, together with disturbances of secretion (reddishness and sweating) and with trophic cutaneous changes (blisters) in the region of the ramifications of the nasociliary nerve. Moreover, there is a tactile hyperesthesia of the skin in the region of the ramifications of the infratrochlear nerve and of the external branch of the anterior ethmoidal nerve. The authors point out that the syndrome of the nasociliary nerve is not always fully developed. In some cases the ocular symptoms predominate, while in others the nasal symptoms are most noticeable. They state that Charlin considered the forms with an incomplete symptomatology more frequent than the ones in which it is complete. Because the syndrome is the result of an inflammation of the nasociliary nerve, and in order to give a better insight into the different symptoms, they describe the anatomy of the nasociliary nerve. Further, they show that the inflammation of the nasociliary nerve may be caused by various factors, it may be of local origin or may be caused by systemic disease or by focal infection. They illustrate this by case histories. In the conclusion they mention the part played by the nose in the development of nervous disorders, pointing out that irritation of the trigeminal nerve may lead to disorders in distant organs.

EDITOR'S ABSTRACT

EXTRANASAL PUNCTURE OF THE FRONTAL SINUS U GITTEL *Ztschr f Laryng, Rhin Otol* (Teil 1 *Folia oto-laryng*) 25 371 1934

Gittel gives a history of external puncture of the frontal sinus reviews the various methods and then describes the technic that is employed at the clinic in Heidelberg Following this, he outlines the method that is employed in Würzburg and describes seven cases in which external puncture of the frontal sinus was done after this method In all these cases the puncture was made for diagnostic purposes In five cases it was followed by radical operation In most cases it disclosed what could be expected on the basis of the roentgenologic and clinical aspects However in one case the observations in the course of the subsequent radical operation did not corroborate what had been indicated by the puncture for the operation disclosed an intact mucous membrane in the frontal sinus, while the syringe that had been introduced following the exploratory drilling had contained secretion and particles of the mucous membrane In two instances the exploratory puncture disclosed such slight changes that the radical opening of the frontal sinus was considered unnecessary, and the conservative treatment produced the desired results In one instance the puncture of the frontal sinus took a serious course This experience and the fact that the method is diagnostically not entirely reliable induced Gittel to discontinue the external opening of the frontal sinus for diagnostic purposes He concedes that the method employed in Heidelberg with its subsequent irrigation through a permanent cannula may be better but he himself has refrained from resorting to it in recent years At any rate he thinks that good roentgenograms are of first importance The roentgenologic exposure should be made not only in the occipitofrontal direction but also from the side so as to determine the depth of the frontal sinus He thinks that the posterior wall is often believed to be much thicker than it actually is Often it is as thin as paper and this fact together with the slight depth of the sinus involves the danger of an artificial injury of the posterior wall He concedes that his material is too small to make it the basis of a complete rejection of the external puncture of the frontal sinus However he thinks that the dangers involved in the method make extreme caution necessary

EDITOR'S ABSTRACT.

PLASTIC CLOSURE OF A BUCCO-ANTRAL FISTULA DEVELOPING AFTER OPERATION ON THE MAXILLARY SINUS L STRACK *Ztschr f Laryng Rhin Otol* (Teil 1 *Folia oto-laryng*) 25 379 1934

Strack points out that formerly plastic closure of a bucco-antral fistula was more frequent since the bucco-antral opening was not closed at once but was left open until the cavity had healed At present it is the tendency to close the wound at once, but even in case of primary closure there occasionally remains a fistula Such a failure of primary closure is frequently the result of erroneous evaluation of the relation between the dental system and the maxillary sinus The dental origin of a disorder of the maxillary sinus is often entirely overlooked After discussing some of the dental aspects of the disorders of the maxillary sinus Strack reviews the literature on the various methods that have been suggested for the plastic closure of bucco-antral fistulas He considers the condition of the surgically treated maxillary sinus as the most important factor in the closure of the buccal wound He thinks that this alone explains the favorable results that are obtained with the radical operation according to Caldwell-Luc in which in spite of a rather large bone defect a mere suturing of the wound nearly always results in primary healing provided the possibility of dental after-infection has been excluded He reports that at the Marburg clinic only 18 of a total of 475 operations on the maxillary sinus resulted in bucco-antral fistulas He describes and discusses these 18 cases Only 3 of the fistulas that required plastic operations developed after uncomplicated operations according to Caldwell-Luc In 3 other instances the bucco-antral fistula was the result of trauma and in all other cases a complication on the part of the dental system could be demonstrated This

indicates that in all cases in which the fistula proves refractory it is necessary to consult a dentist. Strack always tried first a primary closure of the buccal wound, even in complicated cases in which large cysts existed. In the 7 cases in which a bucco-antral fistula existed before the operation on the maxillary sinus the plastic closure of the fistula was attempted immediately following the operation, or the fistular canal was freshened. In 3 instances this measure was successful, and in the others the size of the fistula decreased. Whenever a fistula remained, an attempt was made to find the cause of the antral disease by examining and treating the teeth. After that, simple measures, such as freshening and suturing of the fistula or curettage of the fistular canal, were usually sufficient. In the few cases in which a plastic closure was needed, he did not adhere to a certain method but adapted the treatment to the individual requirements.

## EDITOR'S ABSTRACT

STATISTICAL DATA ON INFLAMMATIONS OF NASAL SINUSES F. WILKER, *Ztschr f Laryng, Rhin, Otol* (Teil 1 *Folia oto-laryng*) 25 404, 1934

Wilker calls attention to Graft's new technic of necroptic examination of the upper air and food passages. If this method is employed, the maxillary sinuses, the ethmoid cells and occasionally even the frontal sinus are exposed and laid open for inspection during extraction of the necroptic preparation. The sphenoid sinuses can be exposed on the extracted preparation by sagittal and frontal sections. Wilker employed this method in 2,317 cases. Because the nasal sinuses of children less than 1 year of age are not fully developed their cases were disregarded. The report covers 2,072 cases. Among this number, he found 144 cases of suppurating sinusitis, that is, a percentage of 6.9. In more than half of these cases one of the maxillary sinuses was involved. The incidence of sinusitis was lowest in the frontal sinuses and in the ethmoid cells. In analyzing the material according to age groups, Wilker observed a higher incidence of sinusitis in children from the second to the tenth year of life and in adults beyond the age of 80 years. The incidence was lowest in persons aged between 10 and 40 years. There was a slightly greater incidence of sinusitis in men than in women. Seasonal fluctuations could not be observed. In comparing his results with those of other investigators he found that the incidence of sinusitis in his material was considerably lower, he thinks that this may be partly explained by the fact that his material was considerably larger than that analyzed by the other authors.

## EDITOR'S ABSTRACT

DEPRESSION FRACTURE OF THE ROOT OF THE NOSE. K. VOGEL, *Ztschr f Laryng Rhin, Otol* (Teil 1 *Folia oto-laryng*) 25 426, 1934

Vogel is of the opinion that fractures of the nasal bones can usually be reduced, that is, that the bones can be raised to their normal position by introducing a blunt instrument into the nasal cavities, forcing the depressed bones upward and then bringing them into normal position by lateral pressure. However, this method cannot be employed when, in addition to the nasal bones, the root of the nose and the anterior wall of the frontal sinus have sustained a depression fracture. He describes such a case. An attempt to raise the depressed bones to their normal position from the inside of the nose failed because the instruments could not be brought under the deepest point of the depression. Consequently, an effort had to be made to replace the pressure from within by traction from without. This measure proved successful, and the patient's recovery was uneventful. Vogel illustrates the efficacy of the treatment by means of photographs of the patient, taken before and after the treatment. He considered this report justified because the literature contained no reference to the traction method employed by him. He recommends this method and thinks that it should always be tried before surgical reposition is resorted to.

## EDITOR'S ABSTRACT

## Miscellaneous

INTERNAL STUTTERING H. FREUND, *Monatschr f Ohrenh* 69.146 (Feb) 1935

Freund's studies on internal stuttering are chiefly the result of observations on himself. He points out that several other authors who investigated stuttering in themselves stress the preexperience of the sound difficulty, and in observations on himself he discovered the same. To him, this preexperiencing of the speech difficulties appears as an internal stuttering that is entirely analogous to external stuttering. The pathologic adjustment movements elicited by the extremely vivid imagination of the feared difficulty are the somatic correlation of this internal stuttering. The ego experiences itself as stuttering, when, prepossessed by the difficulty, it internally expresses the words to itself in a testing preexperience, and in this process discovers the difficult word. Thus, internal speaking and the initial motor movements connected with it play an important rôle in internal as well as in external stuttering. Whereas, former investigators stressed the imagining of erroneous speech movements as the important factor in stuttering, these observations stress instead the disturbed attempt at internal speaking. Freund shows that many of the psychologic peculiarities of stuttering are made possible by the phenomena of internal speaking. In the further development of the disorder an introverted deviation takes place. The internal speaking becomes the censor that is placed between thought and external expression of speech. Internal stuttering is accompanied by different somatic manifestations. Respiration may become inhibited, the head may be held stiff, and the look may become staring. Self-observation of the stutterer discloses feelings of tension and disagreeable sensations in the larynx and at the sites of articulation. In discussing the treatment, Freund suggests, in addition to psychotherapy, clear internal speaking with emphasis on the voice factor, on the extension of the syllables and on the rhythm and melody and with overemphasis on rest. This modified internal speaking could eventually be supported by toneless movements of the organs of articulation. Moreover, an attempt may be made to overcome the internal stuttering by directing the attention to indifferent speech activities. The attention should be taken away from experiences in the patient's own body, such as the heaviness of the extremities, the stream of respiration and so on.

EDITOR'S ABSTRACT

RARE FORMS OF PATHOLOGIC CORNIFICATION OF THE MUCOSA OF THE UPPER  
RESPIRATORY AND DIGESTIVE TRACTS G. CLAUS, *Ztschr f Hals-, Nasen- u  
Ohrenh* 37 228, 1935

Claus relates the clinical histories of six patients in whom cornifications developed on the mucosa of the upper food and air passages. In one patient a whitish thickening developed on the right vocal fold. The histologic examination disclosed a pachydermia with chronic nonspecific inflammation and acanthosis and pseudokeratosis of the epithelium. The second patient had whitish areas on the left side of the tongue, which were noticeably elevated above the level of the mucosa. Between these whitish areas there were bluish areas in which the mucosa was atrophic. Keratosis follicularis (Darier's disease) and leukoplakia were thought of. Since the patient's skin was free from changes of this nature, Darier's disease was ruled out, and the condition was diagnosed as leukoplakia. Claus points out that the histologic aspects of leukoplakia resemble greatly those observed in the cornification of the first patient. The third patient had a small tumor on the tongue, which was diagnosed as papilloma verrucosum. This tumor was removed, and the histologic examination revealed considerable cornification of the epithelial portions. The scar that resulted from the removal of the tumor acquired the aspects of a leukoplakia. The fourth patient had immediately above the uvula a circular area that was covered with snow-white cones and spines. Postrhinoscopy revealed that the nasal surface of the soft palate was also covered with white cones and spines. There was considerable fetor from the mouth and nose. Biopsy revealed a cornified papilloma without signs of carcinoma. The tumor was



treated with radium, electrocoagulation and electrotomy, and the patient was discharged. A control examination nine months later disclosed no further tumor growth. The fifth patient had a papilloma of the right vocal cord with considerable cornification. That the cornified papillomas, which generally are benign tumors, may result in malignant degeneration, the author illustrates by reference to the last patient. The histologic examination of the tumor masses disclosed atypically proliferated epithelial nests. The author points out that the cause of these cornifications is not definitely known, but calls attention to the fact that cornification is more frequent in men than in women. Of the six cases reported here five concerned men. He emphasizes that the benign cornifications in the region of the air and food passages must be kept under observation, for malignant degeneration may result.

EDITOR'S ABSTRACT

PROGRESSIVE UNILATERAL FACIAL ATROPHY TREATED WITH A MALLEABLE RUBBER PROSTHESIS IN THE MOUTH. H. W. BØE, *Acta psychiat et neurol* 9 1, 1934

Bøe reports remarkable results obtained in a case of severe progressive unilateral facial atrophy in a woman, aged 38. The treatment consisted of placing in the mouth a specially devised dental prosthesis made of malleable rubber so as to fill the hollows that resulted from progressive wasting of the bone and soft tissue. The prosthesis can be molded from time to time according to requirements of adjustment. Apart from the immediate cosmetic results thus obtained, the atrophic process was brought to a standstill, and in the course of time an actual improvement in the trophic condition of the tissues on the affected side of the face became manifest. The integument over the forehead, cheek and chin recovered its normal color, consistency and ability to show vasomotor reactions (blushing) which previously had been lost. The condition of the bone also improved. The author attributes these effects to the stimulation of the tissues by the pressure and irritation exerted by the prosthesis.

YAKOVLEV, Palmer, Mass. [ARCH. NEUROL. & PSYCHIAT.]

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# ARCHIVES OF OTOLARYNGOLOGY

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## CLIMATE AND THE UPPER RESPIRATORY SYSTEM

C COULTER CHARLTON, M.D.

ATLANTIC CITY, N. J.

Climate may be defined as the atmospheric factors affecting vegetable and animal life, including temperature, humidity, sunlight and movements of the air as winds as well as waters and locations.

As early as 2300 B. C. it was recorded that people from the shores of the Mediterranean Sea traveled eastward to China because of droughts which rendered their former homes impossible. It is not strange to find that the Greek philosophers studied the climate and its influence and that many temples of health were built. Baths were established, water from springs was used, and open air theaters were built to accommodate as many as 20,000 to 25,000 persons. The Greeks perfected physical development above learning and thought that illness of the soul could be reached through the body.

About 300 B. C. Hippocrates, the father of medicine, wrote an interesting book on "Airs, Waters and Places." This book was no doubt the first ever written on climatology.

In the introduction Hippocrates<sup>1</sup> stated

Whoever wishes to investigate medicine properly should proceed thus. In the first place consider the seasons of the year, and what effects each of them produces, for they are not all alike, but differ much from themselves in regard to their changes. Then the winds, the hot and the cold, especially such as are common to both countries, and then such as are peculiar to each locality. We must also consider the qualities of the waters, as they differ from one another in taste and weight, so also do they differ much in their qualities. In the same manner, when one comes into the city to which he is a stranger, he ought to consider its situation, how it lies as to the winds and rising of the Sun, for its influence is not the same, whether it lies to the North or to the South, to the rising or the setting Sun.

Hippocrates used these observations in his practice of medicine, which helped to overcome the superstitions of his day and dominated

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Read at the Forty-Third Annual Meeting of the American Laryngological, Rhinological and Otological Society, Inc., Atlantic City, N. J., June 3, 1937.

<sup>1</sup> Rochester De Lancey. Climatology as Practiced by Hippocrates, *Tr. Am. Climat. & Clin. A.* 28:33, 1912.

medical practice for many years. The first baths were established in Rome about 100 B. C. Their location was chosen for climate and natural springs, and they were the beginning of the fashionable watering places. During the Roman occupation of Britain health resorts and spas were established, some of which still exist. In 1628, in Harvey's time, the practice of medicine was put on a scientific basis. Thomas Sydenham, the father of clinical medicine, emphasized seasonal changes and the effects of altitude in regard to disease, and in the eighteenth century travelers began to realize the great dangers from the unfavorable climates in certain localities.

In the past century numerous climatic diseases have been conquered through the advancement of science. In the past few years members of the medical profession have taken a greater interest in climatic conditions and their effects on the body, for it has been demonstrated that climatic environment and diet have a great influence on development of the body. It is a fact that Italians, Japanese and other persons from foreign countries living in the northern part of the United States are larger, heavier and physically superior to those remaining in their home countries.<sup>2</sup> One may say that there are many other influences which might be responsible, but it has been proved by experiments on mice that climatic conditions greatly influence growth.<sup>3</sup> In the tropics growth of the body is slower. Puberty and maturity of sex function come on earlier in cool climates both in animals and in man.

As the amount of oxygen or the proportion of carbon dioxide may vary between wide limits without producing physiologic effects, the chemical constituents of the air can be discarded as of no great importance. At present the influence of climatic conditions is explained by the physiologic effects of the air on the human body, as influenced by temperature, humidity and movements of the air. The vasomotor contraction of the vessels of the skin due to cold causes dilatation of the vessels in other parts of the body and makes one more susceptible to disease. In a healthy man the internal temperature is usually constant, varying no more than 1 or 2 F. in the Arctic regions or in the tropics. Man, however, can adapt himself to extremes in weather more than any other animal. His skin and vasomotor system have more ability to regulate his heat, which is the end-result of metabolism. The elimination of heat depends on the surrounding air for its evaporation of moisture. If the air is saturated with moisture and there is little or no wind stirring, the heat is not eliminated. It has been shown by

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<sup>2</sup> Mills, C. A. Health and Disease as Influenced by Climatic Environment, *Internat Clin* 2 143 (June) 1936.

<sup>3</sup> Ogle, Cordelia. Climatic Influence on the Growth of the Male Albino Mouse, *Am J Physiol* 107 635 (March) 1934.

Haldane and Smith<sup>4</sup> in observations on miners that during rest the rectal temperature does not increase until the wet bulb thermometer registers 88 F. For each degree or so above that there is a rise in rectal temperature. In moving air the rectal temperature did not rise until a temperature of 93 F or above was reached, which seems to indicate that the velocity of the wind has a great influence on physical comfort at the higher temperatures. The atmosphere is the most important factor in the environment in which men live. By weight, a human being takes as much air into the body as he does food each day. The lungs and the skin are immediately concerned when the autonomic balance is disturbed by too much heat.

The local effects transmitted through the nervous impulses are of great importance. Vascular changes take place in the mucous membranes of the upper respiratory tract as well as in those of the kidneys and splanchnic areas, producing a state of ischemia of the mucous membranes, which are thus more vulnerable to penetration by bacteria.

With the effects of the winds and cold on delicate children, a decided increase of basal metabolic rate is noticed. Many pathologists and physiologists have become interested in the loss of chlorides and dehydration produced by excessive atmospheric heat. The  $p_H$  of the blood is increased, and frequently the carbon dioxide content is lowered. Persons working in excessive heat and sweating freely have become faint and weak because of the loss of chlorides. Many of the large manufacturing companies have installed machines near the drinking water for dispensing tablets of sodium chloride to encourage the men employed to take them and avoid these ill effects.

High winds tend to have the same effect on changing the moisture of the atmosphere and must have some effect on body moisture. Dry air generally causes a feeling of comfort and well-being regardless of the temperature, while moist air leads to discomfort and depression.

On account of differences in conduction of heat, moist cold air feels cooler and moist warm air hotter than dry air of the same temperature. Therefore, the effects on the physiologic mechanism of adaptation to temperature will be much greater and the demand on the autonomic nervous system beyond the point of normal adjustment will be greater, thus increasing vulnerability to disease. Johnson<sup>5</sup> was the first to suggest that the pathogenic effects of catarrh and colds may be linked to the autonomic nervous system because when the climatic

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4 Haldane, J., and Smith, J. L. The Toxic Action of Expired Air, *J. Path. & Bact.* **1** 318, 1893.

5 Peterson, W. F. The Patient and the Weather, Ann Arbor, Mich., Edwards Brothers, Inc. 1936, vol. 1, pt. 2.

conditions cause an unduly frequent change in temperature of great magnitude the autonomic nervous system is fatigued Kuhn<sup>6</sup> expressed the belief that long exposure to cold produces dryness of the mucous membranes and leads to greater susceptibility to infection of the upper respiratory tract Mills claimed that in many types of chronic illness the weather plays an active rôle, for regions of highly changeable temperature and pressure (stormy zones) usually have a population badly affected with chronic respiratory and arthritic troubles, sinusitis, chronic bronchitis, tuberculosis and rheumatoid arthritis

Miller and Cocks<sup>7</sup> brought before the members of the medical profession their experiments on the human body in regard to various temperatures, humidity and movements of the air several years ago Their records were interesting to me, but I felt that their statement that over 50 per cent of laundry workers exposed to moist heat acquire atrophic rhinitis does not apply in Atlantic City When I came here twenty-five years ago and became connected with the Atlantic City Hospital I was surprised that I did not see patients with atrophic rhinitis in the clinics In New York at that time chronic disease of the nose and throat was of that type in about 50 per cent of all cases What few patients with atrophic rhinitis I did observe in the clinics here were persons from out of town who were here for their vacations In all the time I have been here I have never seen a patient with atrophic rhinitis whose entire time was spent at the seashore Besides, I have records of several persons who came here with atrophic rhinitis, but after a few years one would never be able to tell by examining their noses that they had ever had it I was so interested in Miller and Cocks's work that I decided to examine the laundry workers in this city In different hotels and commercial laundries I examined 268 persons, and to my surprise did not find any with atrophic rhinitis These persons had been engaged in laundry work for an average of nine plus years, a great number had followed the work for twenty years or more and several for over thirty years The laundries are all above the ground, with plenty of fresh air and sunshine, and no factories or other agents fill the air with impurities My conclusion is that the climatic environment here is no doubt responsible for the difference

In training for my special work I was impressed with the fact that sea air seemed to be bad for acute infections of the upper respiratory tract After many years of observation I have concluded that that

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6 Kuhn, A. Abhartung und Erkaltung, Berl Klin 21 1, 1909

7 Miller, J. A., and Cocks, G. H. The Effect of Changes in Atmospheric Conditions upon the Upper Respiratory Tract, Tr Am Climat & Clin A 31 31, 1915

TABLE 1—*Meteorologic Data for Various Cities*

	January	February	March	April	May	June	July	August	September	October	November	December
<b>Atlantic City, N J</b>												
Mean maximum temperature	38	36	50	54	68	73	80	80	73	66	53	48
Mean minimum temperature	25	22	38	41	53	62	68	68	63	53	38	34
Difference	13	14	12	13	15	11	12	12	10	13	15	14
Average wind velocity, miles per hour	16.8	15.6	17.5	15.1	14.8	14.8	13.1	14.2	15.9	14.7	16.7	17.7
Humidity, percentage												
8 a m	79	75	83	72	71	82	77	80	82	82	70	77
12 noon	66	64	75	64	65	74	70	72	73	66	55	69
5 p m	70	70	78	70	74	80	80	79	82	75	63	75
Difference between high and low	13	11	8	8	6	8	7	8	9	6	15	8
<b>Los Angeles</b>												
Mean maximum temperature	67.7	63.3	67.4	69.2	73.9	77.9	83.0	82.7	79.0	76.4	78.4	67.1
Mean minimum temperature	51.0	49.4	50.7	52.1	60.0	65.2	64.1	61.4	61.4	58.5	57.1	50.2
Difference	16.7	14.2	16.7	15.1	16.6	17.9	17.8	18.6	17.6	17.9	21.3	16.9
Average wind velocity, miles per hour	5.7	6.5	5.9	5.9	6.0	5.8	5.6	5.5	5.3	5.8	5.8	6.3
Humidity, percentage												
5 a m	56	80	80	85	78	86	84	88	82	75	42	60
12 noon	38	57	52	56	60	53	50	52	49	47	26	44
5 p m	47	65	59	61	56	56	59	56	59	60	34	56
Difference between high and low	18	23	28	29	29	33	34	36	33	28	16	16
<b>Jacksonville, Fla</b>												
Mean maximum temperature	64.5	62.8	73.8	78.4	82.6	87.1	80.8	90.1	87.9	80.3	69.3	67.1
Mean minimum temperature	45.3	44.6	55.6	59.4	66.7	71.0	64.0	74.1	72.8	66.0	52.0	49.3
Difference	19.2	18.2	18.2	19.0	15.9	16.1	16.8	16.0	15.1	14.3	17.3	15.8
Average wind velocity, miles per hour	7.8	8.7	9.0	9.1	8.2	7.4	8.1	6.8	7.0	7.9	8.0	8.5
Humidity, percentage												
8 a m	89	88	82	76	78	79	81	85	86	88	80	93
12 noon	61	54	52	48	54	58	56	58	60	66	58	75
5 p m	70	74	63	63	72	74	72	78	77	83	72	86
Difference between high and low	28	34	30	28	24	21	25	27	26	22	22	18
<b>Portland, Ore</b>												
Mean maximum temperature	48.5	38.9	52.5	64.5	70.7	73.8	77.7	80.4	73.2	68.2	52.9	47.3
Mean minimum temperature	39.8	28.9	38.1	46.6	51.7	56.5	57.8	58.6	53.7	49.1	38.1	40.2
Difference	8.7	10.0	14.4	17.9	19.0	17.3	19.9	21.8	19.5	19.1	14.8	7.1
Average wind velocity, miles per hour	7.7	8.4	6.7	5.6	6.9	6.2	6.5	6.2	6.5	5.3	5.0	6.8
Humidity, percentage												
5 a m	82	73	84	86	82	85	84	82	82	87	83	89
12 noon	73	66	67	58	54	56	53	51	56	60	65	84
5 p m	74	69	68	51	50	54	46	42	49	54	66	84
Difference between high and low	9	7	21	35	32	31	38	40	33	33	18	5
<b>Atlanta, Ga</b>												
Mean maximum temperature	48.8	51.3	68.4	69.5	85.6	91.8	91.5	89.6	86.0	78.4	60.2	54.0
Mean minimum temperature	29.3	32.0	44.9	48.0	60.5	67.1	70.8	70.0	66.1	55.5	40.0	39.2
Difference	19.5	19.3	23.5	21.5	25.1	24.7	20.7	19.6	19.9	22.9	20.2	14.8
Average wind velocity, miles per hour	10.0	10.6	9.5	8.5	6.9	7.2	6.5	6.6	6.9	6.5	8.0	10.2
Humidity, percentage												
7 a m	80	80	84	83	81	75	86	85	86	81	89	78
12 noon	80	60	61	60	51	47	58	57	53	46	60	63
7 p m	68	66	64	68	62	53	71	71	70	67	76	67
Difference between high and low	20	20	23	23	30	28	28	28	33	35	29	15
<b>San Diego, Calif</b>												
Mean maximum temperature	64.5	62.8	63.1	63.7	68.6	70.1	74.3	76.3	73.4	71.1	73.4	66.2
Mean minimum temperature	48.6	49.8	51.7	52.7	57.9	60.5	65.8	66.4	62.7	59.0	54.0	50.0
Difference	15.9	13.0	11.4	11.0	10.7	9.6	9.5	9.9	10.7	12.1	19.4	16.2
Average wind velocity, miles per hour	5.1	7.0	7.3	7.2	7.4	7.2	6.5	6.8	6.8	6.7	5.6	6.4
Humidity, percentage												
5 a m	72	79	80	82	83	86	88	87	85	81	70	69
12 noon	56	64	62	67	69	72	73	73	70	65	53	56
5 p m	68	69	68	69	72	73	74	74	73	72	67	67
Difference between high and low	16	15	18	15	14	14	15	14	15	16	17	13



TABLE 1—*Meteorologic Data for Various Cities—Continued*

	January	February	March	April	May	June	July	August	September	October	November	December
<b>Boston</b>												
Mean maximum temperature	35.3	30.1	49.1	52.7	71.1	74.1	80.0	78.0	70.0	62.8	47.5	42.9
Mean minimum temperature	21.0	15.5	24.4	37.8	50.2	58.2	62.2	61.4	55.2	46.1	31.5	27.0
Difference	14.3	14.6	14.7	14.9	20.9	15.9	17.8	16.6	14.8	16.7	16.0	13.9
Average wind velocity, miles per hour	12.6	11.5	10.7	12.3	11.2	10.0	9.1	8.7	9.8	10.0	11.3	11.0
Humidity, percentage												
8 a m	75	66	78	69	64	71	72	78	78	75	70	79
12 noon	61	59	68	57	51	61	57	60	64	58	55	68
8 p m	67	58	73	63	64	72	70	76	78	69	63	72
Difference between high and low	14	8	10	12	13	10	15	18	14	17	15	11
<b>Chicago</b>												
Mean maximum temperature	25.1	28.5	47.2	51.2	78.5	73.4	84.7	83.0	75.1	61.1	44.8	40.7
Mean minimum temperature	12.9	7.0	32.1	36.1	55.4	55.7	69.0	66.9	61.2	46.1	31.1	27.3
Difference	12.2	21.5	15.1	15.1	23.1	18.7	15.7	16.1	13.9	15.0	13.7	13.4
Average wind velocity, miles per hour	11.1	11.9	11.5	10.7	9.7	9.8	7.1	9.2	9.3	10.3	12.1	11.3
Humidity, percentage												
7 a m	80	78	76	71	70	70	66	78	82	78	73	80
12 noon	72	70	57	58	52	58	55	59	65	62	62	66
7 p m	74	71	61	64	56	59	58	67	73	68	66	74
Difference between high and low	8	8	19	13	18	12	11	19	17	16	13	14

is not true. In both hospital and private practice at the shore I do not observe as many cases of acute purulent disease of the sinuses, ears or mastoids or of tracheal disease as in the cities. From an article read before the American Climatological and Clinical Association by a successful internist, Dr Philip Marvel,<sup>8</sup> who has had over fifty years of observation of the climate here, I quote

Infections are notably less prevalent at the sea-shore, milder in form, and shorter in period of invasion than is observed inland and in large commercial cities, this is especially true when the physical comforts are comparable with climatic advantages. Pneumonia per se is rarely observed in Atlantic City. When seen here it is usually in complication with some other form of infection, and most frequently of the bronchial type, even the latter is comparatively rare, estimated on the basis of City Hospital statistics. The same is also true of various other forms of infectious diseases—gripp, tonsillitis, whooping-cough, influenza, etc. The rarity with which these are associated with pneumonia, endocarditis, pleurisy, sinusitis, synovitis, etc., is no less than remarkable compared with similar cases in the large cities, and chronic sequelae are little heard of where cases are properly observed through the convalescing period, all of which is particularly strong in affirmation that the physical properties of the atmosphere and the relative advantages of the climate of this locality must be, in some measure, both protective and prohibitory.

<sup>8</sup> Marvel, Philip. Some Remarks on Thirty Odd Years of Continuous Climatic Observations in Atlantic City, *Tr Am Climat & Clin A* 28 114, 1912

Huntington<sup>9</sup> stated that changes of temperature of a few degrees during the day are healthful and tend to produce a stimulating effect which induces a relatively low death rate. A sharp drop of temperature or a sharp rise of temperature is not good. Even a stable temperature with no change is not for the best.

Here one has a climate controlled by a large body of water, the ocean, a summer and winter temperature that varies only 13 F. between the mean monthly maximum and the mean monthly minimum, a humidity that averages about 73 per cent, with a wind velocity of 15 miles per hour, a sandy soil which quickly absorbs any precipitation and all that is free from the impurities commonly found in a large city. The summer winds are from the south over the ocean, and the winter winds, from the west and northwest over the native pine and

TABLE 2—*Difference Between Maximum and Minimum Average Hourly Percentage of Humidity, with the Average Velocity of the Wind*

City	January	February	March	April	May	June	July	August	September	October	November	December	Wind, M P H
Atlantic City, N. J.	13	11	8	8	6	8	7	8	9	6	15	8	15.7
Los Angeles	18	23	28	29	28	30	34	36	23	28	16	16	5.8
Jacksonville, Fla.	28	34	30	28	24	21	25	27	26	22	22	18	8.0
Portland, Ore.	9	7	21	35	32	31	38	40	33	33	18	5	6.5
Atlanta, Ga.	20	20	23	23	30	28	28	28	33	35	29	15	8.1
Boston	14	8	10	12	13	10	15	18	14	17	15	11	10.7
San Diego, Calif.	16	15	18	15	14	14	15	14	15	16	17	13	6.7
Chicago	8	8	19	13	18	12	11	19	17	16	13	14	10.3

cedar forests. All this seems to account for the observations made concerning the climatic conditions in this location.

#### SUMMARY

Since the time of Hippocrates members of the medical profession have been interested in the relation of climatic conditions to health.

People are greatly influenced by climate in their ability to resist infection of the upper respiratory system.

The autonomic nervous system plays a great rôle in the lives of human beings, and it behooves all physicians to give it consideration.

Persons working in laundries with high temperature and moist heat do not seem to acquire atrophic rhinitis in this city.

The climatic environment of this locality seems to prevent atrophic rhinitis.

<sup>9</sup> Huntington, Ellsworth. Weather and Health, Bulletin 75, National Research Council, 1930.

After living a few years in the air of the seashore in this location, persons with atrophic rhinitis seem to improve

Acute infections of the upper respiratory system are fewer and not so severe in this climate as in the large cities

According to the records of the United States Weather Bureau of temperature, humidity, sunshine and wind velocity for this city as compared to other localities, Atlantic City has a great deal to offer to those suffering from infections of the upper respiratory tract

# OSTEOMYELITIS OF THE SKULL

COMPARISON OF TWO CASES OBSERVED SEVENTEEN AND FOURTEEN YEARS AGO WITH TWO OBSERVED IN THE PAST TWO YEARS

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WATERVILLE, MAINE

Osteomyelitis of the skull is a condition in which, because of meager personal experience, physicians are dependent on the literature. This is not a systematic paper on the subject. Rather it is an attempt to show the effect of certain outstanding contributions to the literature on the management of the disease. Four cases of osteomyelitis of the frontal bone are reported, two of which were observed seventeen and fourteen years ago and two within the past two years. All the patients were treated radically. In one case, which resulted fatally, the disease was of streptococcic origin. In three it followed acute frontal sinusitis. In one it resulted from an orbital abscess and had its inception in the temporal fossa. No attempt will be made to discuss the etiology, symptomatology, pathology or bacteriology. These have been thoroughly covered in the literature, and repetition without new findings is worse than useless.

In 1913 McKenzie<sup>1</sup> published the outstanding paper on this subject up to that time, quoting from the previous works of Tilley, Luc, Schilling and other investigators. He discussed the mode of invasion, stating that it can take place along the venous channels as well as by direct extension. He recognized regeneration of bone taking place after the activity of the process had subsided. He stated that extradural abscesses are to be expected. A sure diagnostic sign is edema, often some distance away. "The disease burrows like a mole in the earth and, like a mole, throws up mounds here and there as it goes along." He quoted Killian as reporting the occurrence of thrombophlebitis of the longitudinal sinus following osteomyelitis. He suggested distant trephining and urged immediate and radical operation. "Wheresoever the disease has spread, there must the surgeon follow it."

CASE 1—In 1920 a girl aged 18 was referred to me because of headache, fever and swelling over the left eye of three weeks' duration following influenza. The eyelid was red and swollen and showed a discharging fistula where it had

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Read at the Fifty-Ninth Annual Congress of the American Laryngological Association, Atlantic City, N. J., June 1, 1937

1 McKenzie, D. Osteomyelitis of Frontal Bone. *J. Laryng.* 28:6, 1913-1914.

been incised by her local physician. There was edema extending almost to the hair line and another discharging fistula about 1 inch (2.5 cm) above the left eyebrow. Culture showed a growth of *Staphylococcus aureus*. Nasal examination gave essentially negative results. Roentgenograms showed small frontal sinuses, the left was cloudy, and just above it was an area of osteomyelitis about 1 inch (2.5 cm) in diameter. Operation was performed through an incision above both eyebrows, at the level of and including the fistulous tract. Necrotic bone was widely removed, exposing granulations on the dura, until normal-appearing bone and healthy dura were encountered. The inner table showed destruction beyond what was evident in the external layer. The left frontal sinus was opened from above, and the inner table, which was necrotic, was removed. The outer wall appeared solid and was not disturbed. The incision was kept open, and the wound was dressed with dichloramine (tolueneparasulfondichloramide) twice daily. Three weeks later the frontal sinus was exposed by an incision through the eyebrow and the floor and remaining portion of the inner table



Fig 1 (Case 1)—Roentgenogram of a patient operated on seventeen years ago, at which time a large portion of the frontal bone was removed. This shows considerable regeneration.

were removed. Convalescence was uneventful except for some temporary diplopia. The original wound filled in with granulations and finally healed with rather a large scar. No plastic operation was attempted, as she could cover the scar easily with her hair. She has remained well since. She married and moved to California. Through the courtesy of Dr. Hill Hastings I was able to obtain recent roentgenograms of her skull. These show considerable regeneration of bone.

**CASE 2**—In 1923 a boy of 8 years was examined because of swelling and edema above the eyebrows in the midline following acute frontal sinusitis. Roentgenograms showed small cloudy frontal sinuses, the left being rudimentary. The right was opened externally through the floor, and a drain was left in the incision. No attempt was made to disturb the lining. The temperature, which had been elevated, dropped to normal. In a few days the parents took the child home from the hospital against advice. One month later he returned, complaining of severe headache. There was edema over the forehead and a purulent discharge from the incision, from which *Staph aureus* was cultured. Roent-

genograms showed definite osteomyelitis. The frontal bone was exposed by an incision through both eyebrows and across the bridge of the nose. Necrotic bone was found above the frontal sinuses, considerably beyond the area indicated in the roentgenogram. This was removed, exposing dura covered with granulations. Removal was continued until healthy-appearing bone was encountered. The incision was kept open. Three weeks later a Lynch operation was performed on both frontal sinuses. The patient had an uneventful convalescence and except for a depressed scar seemed perfectly well. Eight years later he had acute frontal sinusitis on the left side, which subsided on probing of the sinus and establishment of drainage. I have not seen him since that time, but, as far as I can find at the time of writing, he is well and enjoys a reputation as a semiprofessional football player.

There were considerable procrastination, hesitation and doubt in the management of these cases, perhaps more than is evident from the reports. Edema did not assume the diagnostic significance that it would today. Operation was not done until the roentgenograms gave strongly positive evidence of involvement. It was indeed fortunate that the process in these cases was not especially virulent and that recovery followed one fairly generous removal of bone. This was done with considerable misapprehension as to the final result of the defect. McKenzie's admonition for early and radical operation may have been weakened by the emphasis placed on the differentiation between the discrete, self-limited type of the disease and the diffuse spreading form. At the time the importance of this differentiation seemed to outweigh the necessity for early operation. Munro<sup>2</sup> said "Actually the pathological process is fundamentally the same, the difference being due to the rapidity and extent of involvement of the venous channels in the diploe, and the resulting variation in the amount of bone destruction."

In the last ten or twelve years the necessity for radical surgical operation in osteomyelitis of the skull has been stressed by a number of writers, including McKenzie,<sup>3</sup> Tobey,<sup>4</sup> Bulson,<sup>5</sup> Woodward,<sup>6</sup> and Wilensky.<sup>7</sup> Munro's studies definitely showed that the chances for recovery are much better with radical treatment than with a more con-

2 Munro, D. Nontraumatic Osteomyelitis of the Flat Bones of the Skull. *Tr South S A* **43** 403, 1930.

3 McKenzie, D. Further Observations on Spreading Osteomyelitis of the Skull. *J Laryng & Otol* **42** 293, 1927.

4 Tobey, H. G. in discussion on Imperatori, C. J. Brain Abscess (Frontal Lobe) Complicating Frontal Sinusitis. *Tr Am Laryng A* **49** 34, 1927.

5 Bulson, A. E. Jr. Osteomyelitis of Frontal Bone as a Complication of Frontal Sinusitis. *J A M A* **86** 246 (Jan 23) 1926.

6 Woodward, F. D. Osteomyelitis of Skull. Report of Cases Resulting from Frontal Sinus Infection with *Staphylococcus*. *J A M A* **95** 927 (Sept 27) 1930.

7 Wilensky, A. O. Association of Osteomyelitis of the Skull and Nasal Accessory Sinus Disease. *Arch Otolaryng* **15** 805 (June) 1932.

servative policy. Certain other writers, including Blair and Brown,<sup>8</sup> were definitely on the conservative side. In 1931 Furstenburg's<sup>9</sup> celebrated paper, based on clinical and pathologic studies in fourteen cases, was read at a meeting of the American Laryngological, Rhinological and Otological Society. He clarified McKenzie's idea of venous extension by postmortem observations of retrograde thrombosis and showed how extradural abscesses, separating the bone from the dura, favor extension of the osteomyelitis. He showed the necessity for radical removal of bone well beyond the obvious limits of the disease and presented evidence that regeneration of bone, previously suggested by McKenzie, is a frequent occurrence and that large portions of the skull can be removed without apprehension. In 1933 Mosher and Judd<sup>10</sup> presented what is probably the outstanding paper of all time on this subject. Based on histopathologic studies, this paper stressed the practical importance of edema as a diagnostic sign and as a guide to the extent of bone to be removed. It defined quantitatively what McKenzie called "the obvious limits of the disease." It showed that the roentgen findings are from seven to ten days late and that the infection is from 1 to 2 inches (2.5 to 5 cm.) beyond the area shown in the roentgenograms. In dramatic terms physicians were admonished to operate early and thoroughly. There were no equivocation and no qualifying statements. An ideal operative technic was outlined. Once the diagnosis is established, there is no place for watchful waiting on the chance that the process will remain self-limited. "Osteomyelitis writes across the patient's brow, not only the diagnosis, but the treatment."

CASE 3—(Observed in consultation in a neighboring hospital. While all the operations were performed by myself, the patient was not under my direct care until after the operation for osteomyelitis.) A girl of 14 had severe frontal pain, with swelling of the lids of the left eye, after swimming. The temperature ranged between 101 and 102 F. The left middle turbinate was swollen. Roentgenograms showed cloudy left ethmoid sinuses. The sinuses were opened intranasally, and pus was obtained. Four days later there was increased swelling of the eyelid. I was called again, and a Lynch operation was performed. Necrotic bone was found at the inner upper angle of the orbit, and the frontal sinus contained pus. The lining was dark, friable and loosely attached. This was removed as gently as possible. When she was seen again, four days later, there were a

8 Blair, V. P., and Brown, J. B. Septic Osteomyelitis of the Bones of the Skull and Face. A Plea for Conservative Treatment, *Ann Surg* **85** 1 (Jan) 1927.

9 Furstenburg, A. C. Osteomyelitis of the Skull. The Osteogenetic Processes in the Repair of Cranial Defects, *Tr Am Laryng, Rhin & Otol Soc* **37** 1, 1931.

10 Mosher, H. P., and Judd, D. K. An Analysis of Seven Causes of Osteomyelitis of the Frontal Bone Complicating Frontal Sinusitis, *Tr Am Laryng, Rhin & Otol Soc* **39** 289, 1933.

profuse nasal discharge, slight edema over the eyebrow and a temperature of 104 F. Roentgenograms showed no evidence of osteomyelitis. A revision of the frontal sinus was done, and pus was found retro-orbitally. A rubber drain was inserted, and the incision was left open. The temperature dropped to normal, and she seemed better.

Nine days later there was definite pitting edema extending over the whole forehead to the hair line. While the roentgenograms still failed to show evidence of osteomyelitis, operation was immediately performed, Mosher's reversed T incision being used. The bone was trephined in an endeavor to get beyond the area of involvement. This necessitated removing bone well back to the coronal suture and laterally into the left temporal fossa. A large epidural abscess was found to the left of the midline. The flaps were sutured back, leaving the field open and a blood transfusion was given while the patient was on the table. Culture showed a growth of *Streptococcus*. Repeated cultures confirmed this.

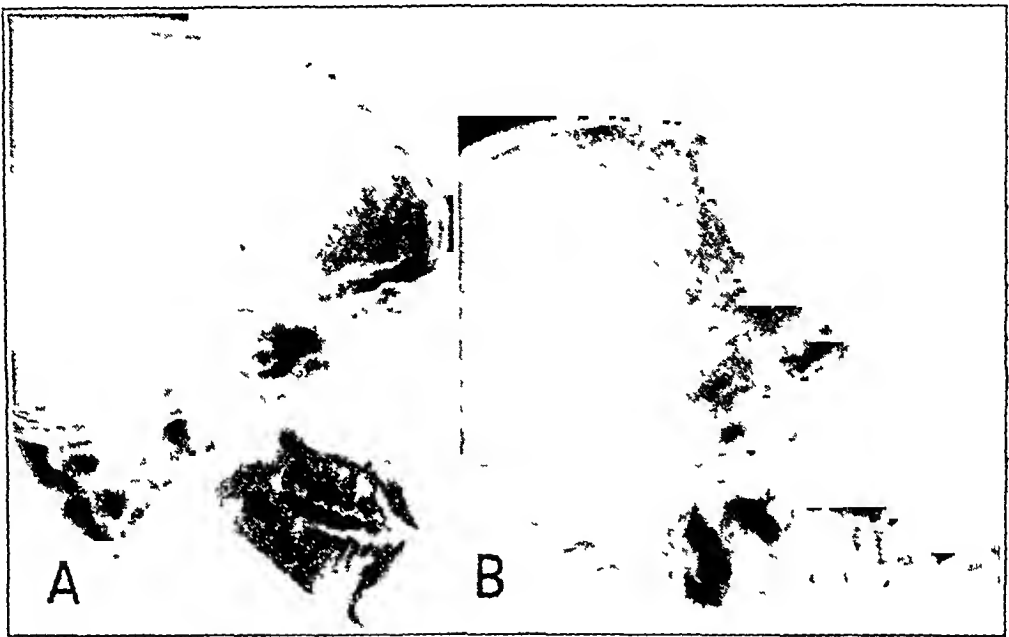


Fig 2 (case 3) —*A* large diploic veins in the frontal bone. No roentgenologic evidence of osteomyelitis was present, yet operation revealed involvement almost to the coronal suture, as well as a large epidural abscess. *B*, roentgenogram after operation, showing the extent of removal of bone.

In the first few weeks following operation the patient had several metastatic abscesses on the wrist and the coccyx, followed by pneumonia at the base of the left lung. This cleared, and she seemed to be progressing favorably. Two months after the resection of the frontal bone she had headache, vomiting and slight facial weakness on the left side. The eye grounds were reported to be normal on repeated examination. Definite bulging of the dura became apparent. There were ankle clonus and a positive Babinski sign. Abdominal reflexes were abolished. There was incontinence of urine. Operation disclosed a large, fairly well encapsulated abscess of the right frontal lobe. The overlying tissue was coned out with the cutting current and a Mosher drain was introduced into the abscess cavity. She improved for about a month, and then began to show distinct changes in personality and became aphasic. Bulging was noted in the dura on the left.



side The left frontal lobe was explored, an abscess found and a Mosher drain introduced She failed rapidly from then on and died two weeks later, fifty days after the first operation for abscess of the brain and one hundred and thirteen days after the resection of the frontal bone

Permission for postmortem examination could not be obtained This patient showed leukopenia throughout her illness, the highest white blood cell count at any time being 10,000

This was a case of streptococcic infection following swimming, in which the osteomyelitic process became well advanced and in which, after it was apparently eliminated, there ensued a sequence of metastatic abscesses, pneumonia and abscess of the brain The persistently low white blood cell count would seem to indicate a low resistance, yet the patient managed to survive this series of complications for almost five months Mosher<sup>11</sup> stated that the worst sinus infection and osteomyelitis follow swimming Several writers, notably McKenzie and Woodward, have stated that streptococcic infection is apt to result fatally In Williams and Heilman's<sup>12</sup> recent paper they suggested from the findings in two cases that an anaerobic streptococcus may be the causative agent of this lesion One obvious handicap in the management of my case was the fact that the patient was in another hospital and not under my personal observation and control at all times The magnitude of the problem inherent in these cases makes any attempt at handling them, except under the most favorable circumstances, prohibitive In reviewing the case, it would seem that draining the frontal sinus externally without closure at the onset would have been preferable Primary closure of the incision in the frontal sinus may be a factor in the development of osteomyelitis Undoubtedly the frontal bone could well have been resected earlier, as there was marked edema well to the hair line when this was done When it was removed, it was removed radically, well beyond the limits of involvement, and there were no signs of recurrence of the osteomyelitis Whether the abscess of the right frontal lobe was not completely drained and itself invaded the left lobe or whether this later manifestation was a second abscess is debatable The virulence of the infection and the persistently low resistance of the patient are factors which must be kept in mind

CASE 4—This patient was a woman of 30, poorly developed and nourished, who had been admitted to the hospital on July 21, 1936, in the ophthalmologic service of Dr H F Hill, with a diagnosis of orbital abscess Examination at this time, according to the hospital records, showed "marked redness and swelling of both lids, definite proptosis, limited muscular movement and pupils 4 mm

11 Mosher, H P Osteomyelitis of the Frontal Bone, *J A M A* **107** 942 (Sept 19) 1936

12 Williams, H L, and Heilman, F R Spreading Osteomyelitis of the Frontal Bone Secondary to Disease of the Frontal Sinus, *Arch Otolaryng* **25** 196 (Feb) 1937

in diameter and not reacting. The vitreous was hazy, and the nerve head was just visible as a hazy blurred area. There were no vision and no perception of light." The Kahn and Hinton tests gave negative results. Exploration of the orbit revealed considerable brawny induration but no pus. Roentgenograms of the skull at that time showed no involvement. She was extremely ill for some time, the temperature ranging between 101 and 102 F. Spinal puncture yielded normal fluid.

Apparently the patient was making a slow convalescence. The temperature had been normal for several days, when there was a sudden rise to 102 F. She was seen by Dr. T. E. Hardy, of the medical service, who noted an area of pitting edema in the left temporal region, extending from the zygomatic arch upward onto the scalp. He made a tentative diagnosis of osteomyelitis. She was then transferred to my service. Roentgenograms showed a well defined area of mottled osteomyelitis involving the temporal fossa. With the patient under anesthesia with tribromethanol in amylene hydrate a circular flap was made with the base down, somewhat similar to that used for a subtemporal decompression. The bone of the temporal fossa was completely necrotic, and pus and granulations were found coming from the orbit. Her condition precluded the ideal method of working from above downward, so it was necessary to remove the diseased bone as rapidly as possible, outward from the necrotic area. The dura was covered with granulations. Removal of bone was continued well beyond the diseased area. As is usual in these cases, there was considerable loss of blood. Two wide strips of Penrose rubber tubing were laid over the dura horizontally, and the extreme upper edge of the circular flap was sutured in place. This left a large tunnel extending from before backward separating the dura and the periosteum. She was given a blood transfusion. Culture showed a growth of *Staph. aureus*. The dressings were changed twice daily in an endeavor to keep the tunnel free and draining. She made a slow but uneventful convalescence from that time on. The flap healed without the necessity of a secondary plastic operation and with little deformity. She was discharged from the hospital on October 9, forty-two days after the operation. She has been under observation since and has shown no signs of recurrence at the time of writing.

In this case the osteomyelitis was secondary to an orbital abscess. In Munro's study of two hundred and twenty-one cases, in ten the condition was of this origin. Possibly a more successful exploration of the orbit in the first days of her illness might have obviated the infection of the bone. Mosher has called attention to the extreme vulnerability of the external angle and the temporal fossa of the frontal bone. This is well illustrated in this case. The type of incision may be open to criticism. It was selected because of a desire to avoid cutting the temporal artery and to save as much as possible of the blood supply of the scalp. The wide tunnel of tubing worked well in this case, although I was prepared to discard it, turning the flap well back had the postoperative course indicated it. As it was a secondary plastic operation was avoided and the patient was able to be discharged in a fairly short time. While I was not familiar with their experience at that time, Williams and Heilman described a somewhat similar flap in their recent publication.

In these two cases the diagnosis was made mainly on the basis of edema, although the last patient showed positive roentgen findings when I first saw her. Operation was performed immediately, without hesitation, once the diagnosis was made and was carried out radically, with wide resection of bone. Although the first patient died, apparently the osteomyelitic process had been eliminated. Blood transfusions were used in both cases postoperatively. The use of bacterio-

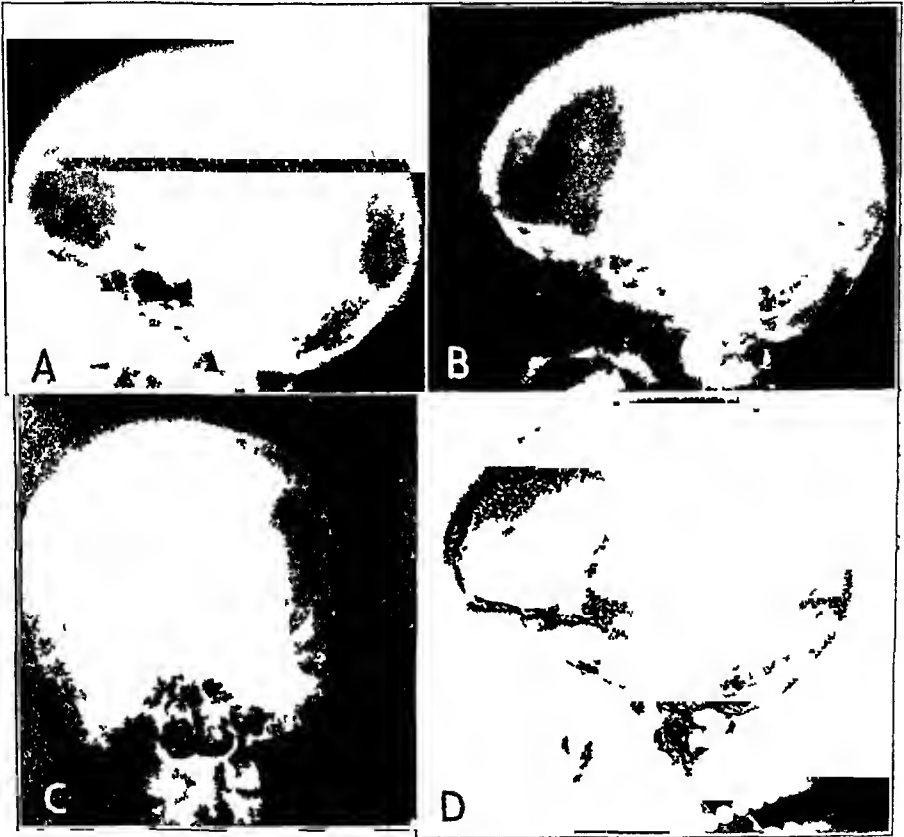


Fig 3 (case 4)—*A*, roentgenogram showing osteomyelitis, secondary to orbital abscess and having its inception in the temporal fossa. *B*, roentgenogram after operation, showing the extent of removal of bone. *C*, anteroposterior view of the same patient. *D*, roentgenogram nine months after operation, showing beginning regeneration of bone. The patient was perfectly well, with little deformity.

phage was considered in the last case, but the patient did so well with simple sterile dressings changed frequently that it was not resorted to.

In such a condition as osteomyelitis of the skull, any change in attitude on the part of the operator in such a fourteen year period must reflect the influence of the literature rather than of personal experience. My own reactions to the literature of the time, as sum-

maized in McKenzie's paper, perhaps because of imperfect understanding or insufficient study, were such that many of the important points were definitely overshadowed by the necessity for differentiation between the types of the disease. This seemed to be the first consideration. It is still emphasized in many later contributions by other writers. If it is a matter of degree of activity, based to a certain extent on the virulence of the infection and the resistance, age and type of bone of the patient, it would seem most important after a diagnosis of osteomyelitis is made to recognize the possibilities of diffusion early, rather than spend time and mental effort on differentiation of types. Furstenburg has shown that spongy bone may be found in both the anterior and the posterior wall of the frontal sinus, in close proximity to the lining membrane. Young persons have more diploic bone than do older persons. This predisposes to diffusion of the process. If one keeps the possibilities of extension by retrograde thrombosis in mind, the appearance of edema, sepsis of varying degree and headache in the presence of suppurative sinusitis certainly calls for immediate action rather than watchful waiting.

The literature of the last few years, especially the papers of Mosher and of Furstenburg, has greatly facilitated the management of osteomyelitis of the skull. Diagnosis is made easier, and proper treatment is indicated in definite terms. The significance of edema, the relative lateness of positive roentgen findings and the necessity for immediate and radical operation have been stressed in a most impressive manner. The value of this is most obvious. It makes for confidence and for early decision, rather than for procrastination and doubt. While the activity of the process may vary, depending on the virulence of the infecting organism and the resistance and age of the patient so as to make possible, at times, a limited, sequestering form of the disease, in the vast majority of cases, unless the chronic form is obvious, it would seem good judgment to operate radically, as soon as the diagnosis is established, especially in the younger patient.

#### SUMMARY

An attempt is made to show the value of outstanding papers on the management of certain conditions in which, because of meager personal experience, physicians are especially dependent on the literature. This is illustrated by the reports of four cases of osteomyelitis of the frontal bone, one occurring seventeen and one fourteen years ago, and two within the past two years, contrasting the two groups. As a result of certain papers, notably those of Mosher and of Furstenburg, the management of osteomyelitis of the skull has been greatly facilitated.

# PROGNOSIS IN LARYNGEAL TUBERCULOSIS

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The prognosis in tuberculosis of the larynx has decidedly improved since Sir Morrell Mackenzie<sup>1</sup> in 1880 made the statement so often quoted that "the prognosis of laryngeal tuberculosis is always extremely unfavorable and it is not certain that any cases ever recover" Search of the French and German literature of that era revealed the prognosis to be equally hopeless Sir St Clair Thomson<sup>2</sup> in 1924 said "A Group I patient (that is a slight case) with a laryngeal lesion has a worse prospect than a Group II case with a sound larynx And a Group II case (that is a severe case) with throat trouble has a gloomier expectation than if he had a healthy larynx, but lungs so involved as to be classed in Group III (that is an 'advanced' case) Differently expressed, the discovery of a laryngeal lesion at once moves a case down to a lower group" Although this high authority sounded a less hopeless note than was expressed a generation before, it indicates that tuberculosis of the larynx was still regarded as a serious complication of the pulmonary disease However, since that time (1924) a notable advance has been made in three directions in treatment—more prolonged rest in bed, surgical operation on the chest (including pneumothorax) and earlier and more general application of electrocautery In making a prognosis it is all important that one make not only a thorough examination of the larynx but also an accurate physical examination of the chest, including stereoscopic roentgenograms The sedimentation rate should be taken, for it is now regarded as a fair measure of the patient's resistance to the infection

Levy<sup>3</sup> rightly said "I know of no disease into the prognosis of which so many factors enter as into that of laryngeal tuberculosis" It is desirable to make a fairly accurate prognosis for the reason that the whole method of treatment may be determined by the patient's

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Read at the Fifty-Ninth Annual Congress of the American Laryngological Association, Atlantic City, N J, May 31, 1937

1 Mackenzie, Morrell Diseases of Throat and Nose, London, J & A Churchill, 1880, vol 1, p 383

2 Thomson, St Clair The Mitchell Lecture on Tuberculosis, Brit M J 2 841 (Nov 8) 1924

3 Levy, Robert Laryngeal Tuberculosis, J A M A 60 1518-1523 (May 17) 1913

chance of a cure or an arrest of his pulmonary condition. It would be obviously unwise to attempt to effect a cure of the laryngeal complication if the pulmonary condition has advanced to the stage at which an early termination can be expected. This does not preclude the use of any necessary measures for the relief of pain, which is so frequent a symptom of this disease. There is also an economic and social side—patients who are hopelessly diseased should be spared the financial burden of remaining in a sanatorium which separates them from relatives and friends. However, there are cases, particularly when there are children in the home, in which it may be wise from a preventive standpoint for the patient to continue treatment in a sanatorium. In discussing prognosis I shall refer to diagnosis and treatment only so far as they affect the outcome of the disease.

As to early diagnosis, Looper<sup>4</sup> wisely said: "Too much cannot be said about the importance of early diagnosis in these cases, for intrinsic lesions respond readily to treatment and cases can be effectively cured." It is my belief that local treatment has an important bearing on the outcome both from a laryngeal and from a pulmonary standpoint, and due emphasis will be placed on this later.

It is worthy of note that the mortality from tuberculosis has been reduced to about one-third of what it was thirty years ago, and it is not unreasonable to suppose that the morbidity has been reduced in a corresponding ratio, with a still greater reduction in the occurrence of the laryngeal complication. This great reduction in mortality is due to several factors, among them an intensive educational program carried on in the way of prevention, isolation of patients in sanatoriums during the infectious stage and advances made in their medical and surgical care. The improvement in the social and economic status of the people, particularly in the hours of labor, has undoubtedly played a part in lessening the incidence of this dread disease. It is thought by some that an increase in immunity has been built up by the present generation. Physicians can claim a measure of credit for stressing the importance of early diagnosis and also the practice of preventive measures by encouraging routine examination of school children in order to discover the presence of this disease in a latent stage existing as childhood tuberculosis. Full credit should also be given the veterinary profession for their aid in the eradication of bovine tuberculosis from dairy herds. There has also been a more general use of pasteurized milk.

The change in the attitude of physicians toward this important complication has made for a better prognosis, for those who specialize in

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<sup>4</sup> Looper, Edward A. *Tr. Am. Laryng., Rhin. & Otol. Soc.*, 1926, p. 78

pulmonary tuberculosis no longer advise that the larynx be left severely alone, with the statement that it will improve as the pulmonary condition advances toward recovery. As Sir St. Clair Thomson<sup>2</sup> said "A larynx may improve or get well while the lung disease remains quiescent or gets worse, but if the disease in the larynx advances the pulmonary disease cannot possibly become arrested and soon makes progress." Levy,<sup>5</sup> discussing prognosis, said "The relation between pulmonary and laryngeal tuberculosis must be considered from two standpoints, namely, the influence the laryngeal involvement has upon the pulmonary and that of the pulmonary disease upon the progress of the laryngeal complication."

It cannot be questioned that the situation and the type of the lesion of the larynx have an important bearing on the prognosis. Lesions situated on the posterior commissure or on the vocal chords offer the most favorable prognosis, and fortunately these are the situations in which the lesion is most frequently encountered. In tuberculosis as in cancer, the intrinsic lesions in these locations offer a more favorable prognosis than those which appear on the epiglottis, the aryo-epiglottic folds or the arytenoid cartilages. The unfavorable prognosis in these cases is due not only to the more painful nature of the lesion, which interferes with nutrition, but to the difference in the type of tissue involved. Four types of laryngeal lesion are recognized—infiltration, ulceration, perichondritis and tuberculoma. It is obvious that these types often merge into each other. Pseudo-edema is noted at times, involving chiefly the arytenoid cartilages and the epiglottis. This type of lesion is usually painful and from its very nature adds to the gravity of the prognosis. Multiple lesions of the larynx are more serious than those in which the tubercle appears at a single site. For instance, a tuberculous process appearing on both sides of the larynx is more serious than a lesion confined to one side. Perichondritis of the epiglottis or the arytenoid cartilages offers an unfavorable prognosis, and when a pale edematous swelling in this region is noted the prognosis becomes well nigh hopeless. It is thought that this type of lesion is often due to an infection of the blood stream, as distinguished from the intrinsic lesions, which are believed to arise from contact with sputum. It is well to bear in mind that there is a strong tendency for the lesion in the larynx to be of the same type as that found in the lungs, that is, when there is an exudative type of involvement in the lung, one can expect an ulcerative type in the larynx, and when there is a fibrotic type in the lungs, there is likely to be fibrosis in the larynx, with healing tendencies. To this, however, there are many exceptions.

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5 Levy, Robert. Prognosis of Laryngeal Tuberculosis, *Laryngoscope* 14 787-790, 1904.

As to age, it has often been observed that the young bear this disease badly, particularly in the second and third decades. Fortunately, this complication is not found in the first decade and is infrequent in the second. This apparent immunity in the early years of life is probably due to the failure to produce sputum. Sex seems to have no influence on the prognosis, except that pregnancy adds to the gravity. Tuberculosis of the middle ear or the tongue adds somewhat to the gravity of the condition, for this indicates a poor resistance to the infection.

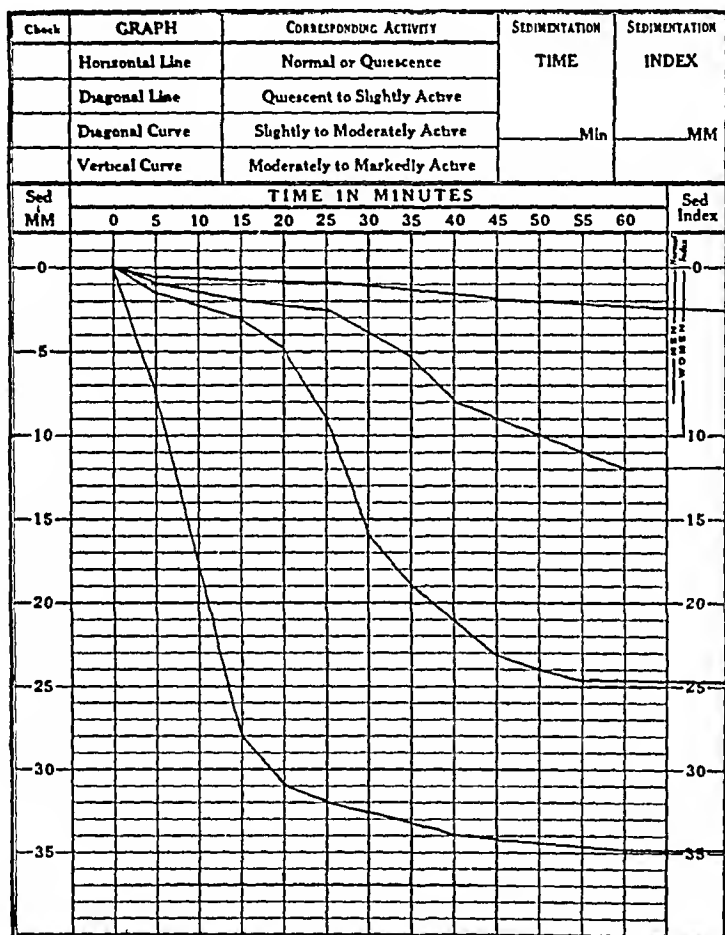


Fig 1—Four types of sedimentation curve (Cutler)

If the complication in the larynx is associated with a similar lesion in the pharynx, genito-urinary region or intestinal tract, the prognosis may well be considered grave. It would be needless to say that any severe complicating disease, such as diabetes, nephritis or syphilis, makes the prognosis more unfavorable. Just as physicians have noted that the local condition in the larynx affects the pulmonary and general condition, the reverse of this is true. Therefore, when a patient with a laryngeal complication is observed to be on the down grade, as evidenced by loss of weight, rise of temperature, increase of thoracic



signs confirmed by roentgen findings and a rapid rate of sedimentation, one cannot make other than an unfavorable prognosis

The sedimentation rate influenced by both the pulmonary and the laryngeal condition is a fair measure of tissue resistance, as I shall attempt to show by slides Ringer<sup>6</sup> said "No definite proof of the cause of increased sedimentation rate has been brought forth, but it is being generally accepted that the phenomenon depends upon the amount of cellular destruction going on in the body In the ordinary wear and tear of life there is constantly present a process of tissue destruction accompanied by a similar amount of tissue repair" To

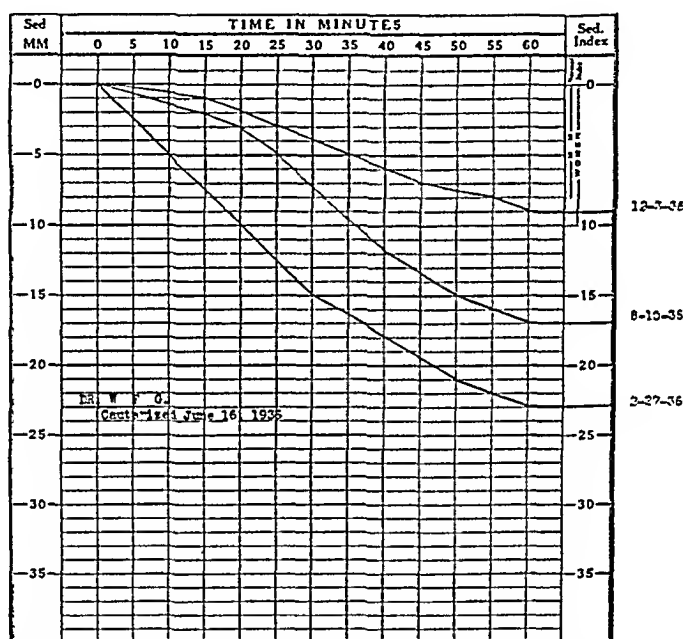


Fig 2—Improvement of sedimentation rate following cauterization of the posterior commissure

quote Cutler "Should the amount of tissue destruction pass beyond the normal then the stability of the blood is seriously disturbed and the red blood cells settle out quickly from the plasma Regardless of the disease present, whether it be active pulmonary tuberculosis, malignancy, pelvic inflammatory disease, an acute infection such as typhoid fever, or any disease in which tissue destruction is going on at a greater pace than normal, the rapidity of settling of the red blood cells is in direct proportion to the severity of the disease" Videbech stressed the value also of the leukocytic index in prognosis, but the

6 Ringer, Paul, and Roach, Mary Blood Sedimentation Test, Ann Int Med 8 258-267 (Sept) 1934

simplicity of determination of the sedimentation rate makes it lend itself more readily to practical clinical use

Patients taking treatment in a well regulated sanatorium where rest in bed and rest of the voice can be enforced have a better chance for recovery than those in a private home or a general hospital. Sir St. Clair Thomson has observed that patients acquiring a laryngeal complication while under treatment at a sanatorium do not offer a favorable prognosis. It has been observed by many, notably Dworetzky,<sup>7</sup> that artificial pneumothorax exerts a favorable influence on the lesion in the larynx by lessening cough and expectoration and raising the

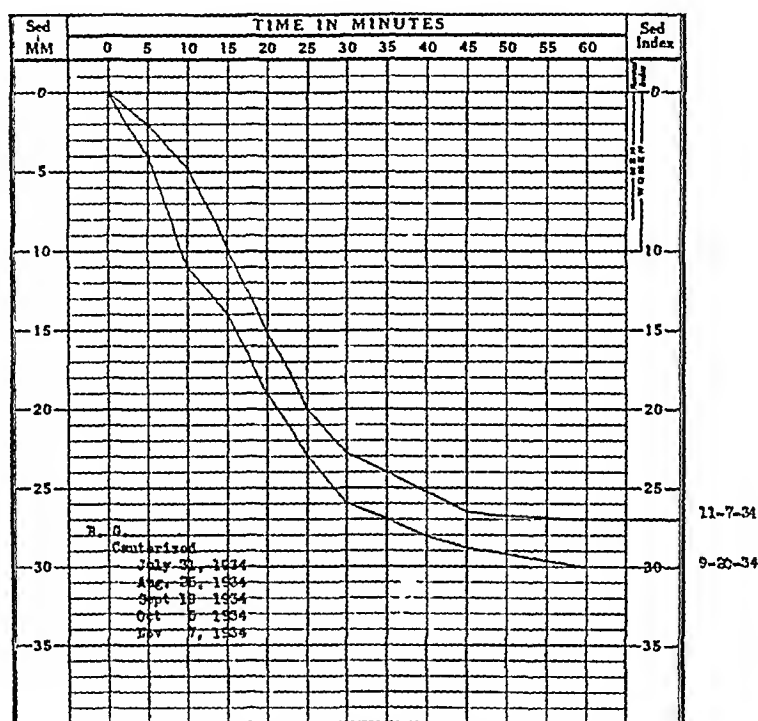


Fig 3—Extensive ulceration of the epiglottis and arytenoid cartilages. Slight improvement in the sedimentation rate followed cauterization

resistance of the body. Thoracoplasty performed in well selected cases can be expected to exert a similar favorable influence.

It can hardly be questioned that the removal of diseased tonsils causing severe systemic disturbance often proves to be of the greatest benefit to patients suffering from chronic inactive tuberculosis of the lungs. However, in the presence of a laryngeal lesion the removal of the tonsils is fraught with the greatest danger. Even though there is no active lesion in the larynx, the possibility of extension from the pharynx should be borne in mind before one enters on a tonsillectomy. Wood

<sup>7</sup> Dworetzky, J. P. Lung Immobilization in the Treatment of Pulmonary Tuberculosis and Its Influence on the Larynx, *Ann Otol, Rhin & Laryng* 39 1111-1124 (Dec) 1930

expressed strong opposition to surgical operations on the tonsils, save cauterization, in practically any stage of pulmonary tuberculosis Newhart<sup>8</sup> and his associates stated "With a careful selection of patients, with the proper preoperative and postoperative care, and with good surgical technic the tuberculosis patient is at least as good a surgical risk as the average ambulatory case" I am of the opinion that the infection which at times takes place in the fossa after the operation results from the spread from infection in the tonsil itself rather than from contact with sputum Rarely, active tuberculosis of the tonsil is present, evidenced by grayish ulceration and at times by the appearance of sub-

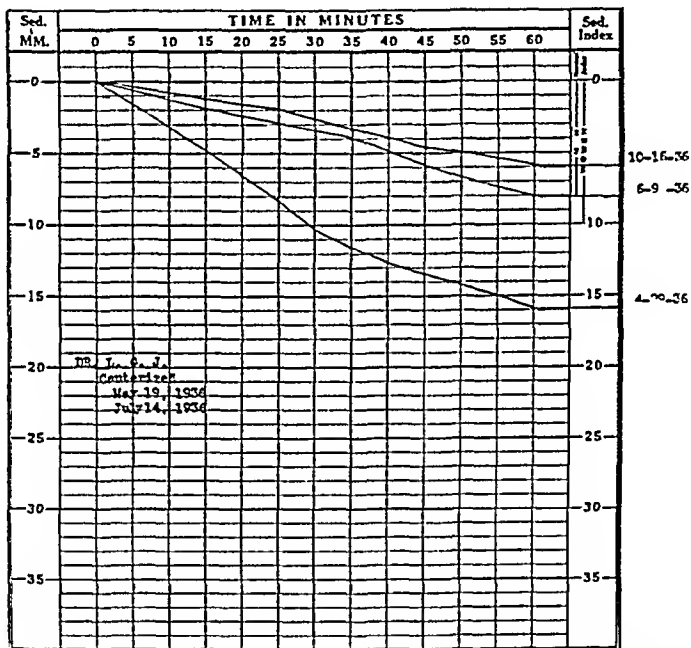


Fig 4—Superficial ulceration of the epiglottis Marked improvement followed rest in bed and cauterization The patient made a good recovery

epithelial tubercles Patients with such a condition are obviously not suited for removal of the tonsils but do respond to the action of cauterization punctures applied at intervals of several weeks A high percentage of tonsils become infected in pulmonary tuberculosis, the infection, fortunately remaining latent so long as the general condition of the patient keeps good and the sedimentation rate remains low No patient complaining of persistent sore throat or hoarseness should have his tonsils removed till an examination has been made of the larynx It

8 Newhart, H, Cohen, S S, and VanWinkle, C C Tonsillectomy in Tuberculosis Incidence and Pathology of Tuberculosis of Tonsils in Adults, Ann Otol, Rhin & Laryng 43 769-778 (Sept) 1934

has been my misfortune to observe too many cases of pharyngeal tuberculosis resulting from ill advised tonsillectomy

As there is a close dependence of the general and the pulmonary condition on the complication in the larynx, particularly when pain is present, it becomes necessary to speak briefly of treatment as influencing the prognosis. There are cases in which the outcome depends on appropriate laryngeal treatment, and for this purpose the value of the electrocautery and of silence overshadows that of all other types of treatment. I shall not enter into discussion of other therapeutic measures. Thomson said "It is the treatment for ease and for cures." Spencer "

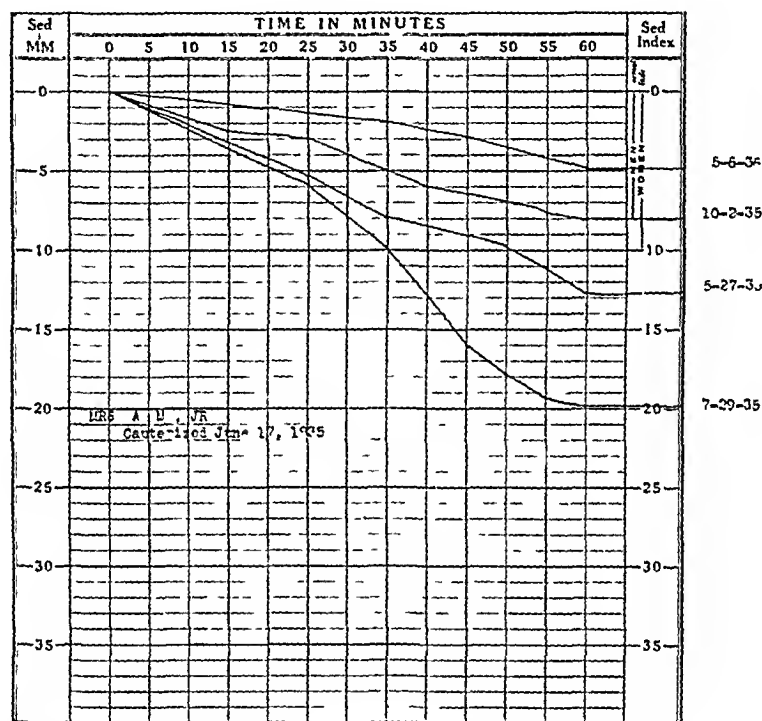


Fig 5—Tuberculous infiltration on the inner side of the left arytenoid cartilage. Marked improvement in sedimentation rate followed cauterization.

said "It is doubtful if any single method of treatment has yielded better results than the cautery." Physicians in America are indebted to George Wood for the introduction of the electrocautery treatment first used in Berlin by Gruenwald<sup>10</sup> (1905). In 1910 Wood<sup>11</sup> made valuable animal experiments proving the healing action of the electro-

9 Spencer, Frank R. Laryngeal Tuberculosis, Philadelphia, J. B. Lippincott Company, 1927, p. 46.

10 Gruenwald, L. Some Observations on the Treatment of Laryngeal Tuberculosis, J. Laryng. 20: 637-644, 1905.

11 Wood, George B. Actual Cautery in Localized Tuberculous Lesions of the Larynx, Tr. Am. Laryng. A., 1911, p. 181.

cautery His<sup>12</sup> enthusiasm for this type of therapy was aptly expressed in these words "It is undoubtedly the method *par excellence* for the treatment of laryngeal tuberculosis, and its use brings to the surgeon that peculiar sense of elation which he feels when, through his interference, suffering and death have been averted" In my opinion there are few contraindications for the use of the cautery It is not advisable when hyperemia alone is present and the site of the offending tubercles cannot be determined Rest of the voice carried out in the hygienic surroundings of a sanatorium is frequently all that is required It is obvious that for patients with advanced lesions of the larynx associated with

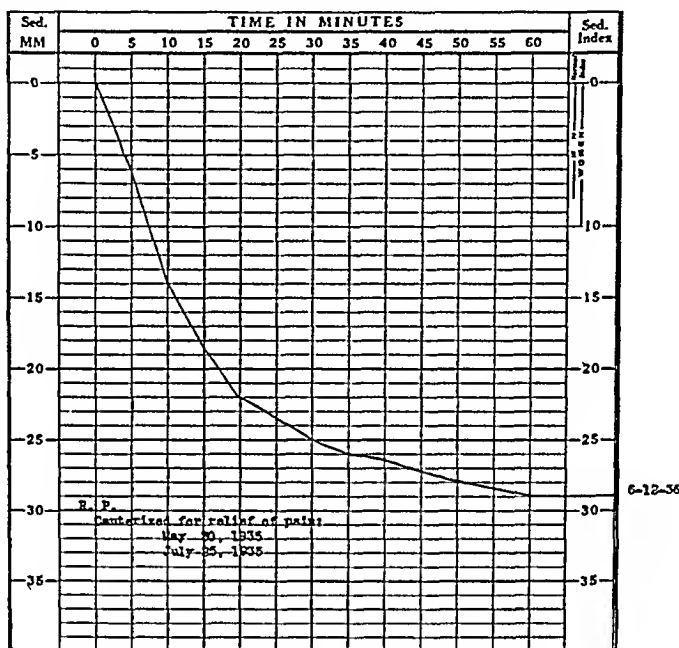


Fig 6—Ulceration in the lower tonsillar fossa Biopsy was performed for diagnosis and a tubercle was found, which spread to the epiglottis and the aryepiglottic fold Cauterization was done for relief of pain The sedimentation rate was high Death occurred on September 10

severe constitutional symptoms cautery should be withheld except for the relief of pain It is in such cases that the sedimentation rate may be the deciding factor in determining the advisability of the use of the cautery

In conclusion, it would seem worth while to speak briefly of the possible danger of section of tuberculous lesions of the larynx Much has been written relating to the danger of biopsy in cancer of this region, but little emphasis has been laid on the danger of extension

12 Wood, George B Use of Electric Cautery in Laryngeal Tuberculosis, Am J M Sc **163** 854-858 (June) 1922

following this procedure when tubercles are present. It is thought that the infection spreads in the larynx by way of the lymphatics. Wood<sup>13</sup> quoted Manassa as describing a thrombosed condition of the lymphatics in the inflammatory area surrounding the active tuberculous lesion of the larynx. He (Manassa) expressed the belief that this area is susceptible to infection and that these findings suggest that the lymphatics serve as a pathway for extension of tuberculous disease. This means not that the primary infection of the larynx comes through the lymph vessels, but only that the spread of the disease inside of the larynx takes place in this way. Wood said: "This observation of Manassa is

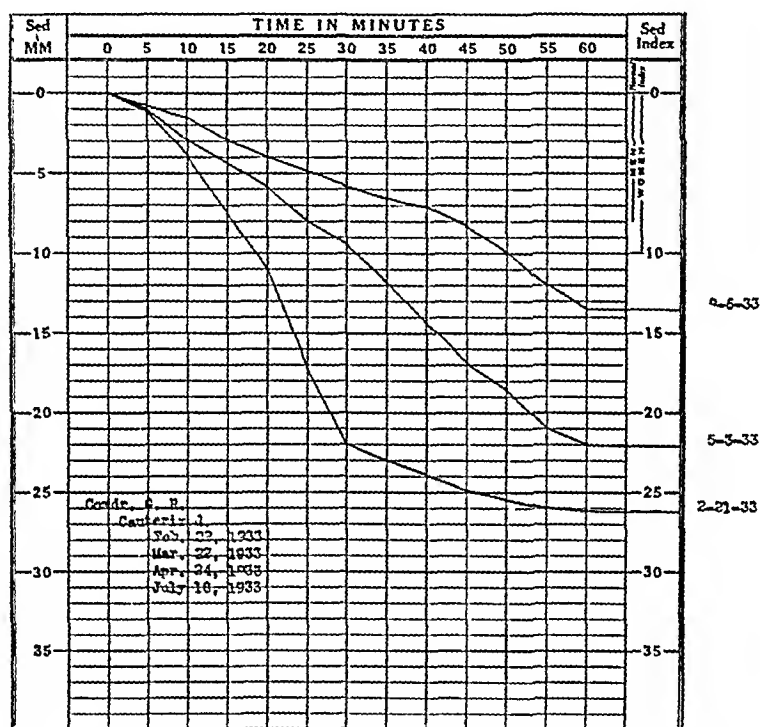


Fig 7—Much swelling of the left arytenoid cartilage with infiltration of the posterior end of the left vocal cord. Cauterization was done on four occasions, the sedimentation rate improved, and good recovery followed.

extremely important although from clinical experience such a method of spread of the disease in the larynx was thought possible. The pathologic proof ought to make one even more careful in avoiding 'intralaryngeal manipulation' that might tend to force bacilli through the tissue." Cases have come under my observation in which the condition was undoubtedly made worse after section of the larynx when the history, thoracic findings and appearance of the lesion pointed the way to a diagnosis of laryngeal tuberculosis. On the other hand, I realize that in certain cases of frank pulmonary tuberculosis there may occur a

13 Wood, George B. Laryngeal Tuberculosis, Arch Otolaryng 8 720-728 (Dec.) 1928

type of lesion in the larynx in which only a microscopic section will determine the diagnosis between cancer and tubercle. However, the occurrence of these doubtful cases should be infrequent. When necessity for this procedure does arise, I agree with Schuster,<sup>14</sup> who advised the sealing of the raw surface with the cautery.

Without my attempting to summarize the advances made in the handling of this still serious condition, I think that those who have been engaged in the work for a generation will agree with me that physicians now enter on the treatment of laryngeal tuberculosis with an entirely different and more hopeful attitude.

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<sup>14</sup> Schuster, Franklin P. Observations on the Larynx in the Tuberculous, *Arch Otolaryng* 25 23-36 (Jan) 1937

# CHOLESTEATOMA OF THE FRONTAL SINUS

GEORGE M' COATES, MD

PHILADELPHIA

Ewing,<sup>1</sup> in discussing tumors of the hypophysis, said that cholesteatoma as well as the true dermoid containing hair and sebaceous material occasionally appears in or near the sella turcica. He intimated that it may take its origin from ectodermal nests carried in with the closure of the vesicles of the brain. In some instances such a so-called tumor may have developed by metaplasia from remnants of the hypophysial duct. Fetal implantation may account for these teratomas of the brain, in which class Ewing seems to have been inclined to place cholesteatoma found in this region. A teratoid tumor at the base of the skull is commonly referred to as buccal ectoderm misplaced in the development of the hypophysis. Ewing stated

The relation of the medullary groove to the ectoderm, the complex step in the formation of the brain and ventricles, and the formation and union of the cranial bones give abundant sources for the development of epidermal growths in the skull. The interpretation of these tumors is further complicated by certain properties of endothelial growth to copy the structure of cholesteatoma, and, finally, traumatic implantation of portions of ectoderm accounts for a small proportion of these intracranial processes.

Ewing described a cholesteatoma as a tumor composed of lamellated waxy or scaly material enclosed in a wall of stratified squamous cells. He quoted Bostroem as concluding that cholesteatoma always arises from embryonal epidermal inclusion. In the case of a cholesteatoma of the frontal sinus reported by Hartley, which seems to be unique, a traumatic origin is supposed. In the case of a dural dermoid lying, as it usually does, close to the skull, there is often a definite connection with the skin by an epithelial canal or a fibrous strand, frequently through a dehiscence of bone and with a bald spot on the corresponding portion of the scalp. Such a tumor must, therefore, it is concluded, arise late, after the skin has formed.

McFarland<sup>2</sup> stated that J. Muller, who originated the name cholesteatoma, first described these "laminated fatty tumors" as having

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Read at the Fifty-Ninth Annual Congress of the American Laryngological Association, Atlantic City, N. J., June 1, 1937.

<sup>1</sup> Ewing, James. *Neoplastic Diseases*, ed. 3, Philadelphia, W. B. Saunders Company, 1928.

<sup>2</sup> McFarland, Joseph. *Surgical Pathology*, Philadelphia, P. Blakiston's Son & Co., 1924.



a dull pearl-like luster and as being composed of "delicate polyhedral cells arranged in concentric lamina between which crystalline fat was deposited. The cells were mutually compressed, pale, clear and anuclear.

Virchow thought that true cholesteatoma arises through multiplication and concentric lamination of epithelial cells." Virchow seemed to think that the cholesterol is a subordinate feature, although usually plates of cholesterol are found between the layers. He expressed the belief that these cells arise through metaplasia of the connective tissue, even though he recognized them as epithelial. If they arise from embryonal inclusion of epidermis, the cells will be epithelial and epidermal.

McFarland, in speaking of cholesteatoma of the ear (middle), attributed it to embryonal inclusion of "epidermal cells attending the closure of the first visceral furrow, which is followed by desquamation and massive accumulation of the cells which become compressed into concentric masses, and later infiltrated with cholesterol." That is definitely not descriptive of a tumor, certainly not of a neoplasm. These masses finally enlarge to the point of rupture through the tympanic membrane, where the appearance, with secondary infection, is that of chronic suppurative otitis media or mastoiditis. Then the cells appear as old and hornified, without nuclei, so that identification is difficult. This conception, as outlined from McFarland, is different from the otologic conception of cholesteatoma of the middle ear and the mastoid. Otologically, it has long been thought that the cholesteatoma is caused by ingrowth of epidermis from the external auditory canal through a marginal perforation of the drum to line the infected spaces of the tympanum and mastoid, replacing diseased mucous membrane. Desquamation takes place, and when the discharge of the desquamated cells is obstructed, as for instance in the aditus, accumulation and lamination occur, with the deposit of cholesterol crystals. Pressure of the accumulating mass tends to extend the boundaries of the original cavity invaded by absorption of bone or pressure necrosis, and the mass becomes infected by bacteria gaining entrance from the originally infected mucous membrane, hence the foul odor of decomposition usually, but not always, associated with this process. The appearance is similar to that of a cholesteatoma formed by embryonal inclusion or by metaplasia and is familiar to every otologist, for it is a condition frequently seen. Its characteristics are the laminated arrangement of the cells, mostly decomposed, the cholesterol crystals, the foul odor and the matrix from which the desquamation takes place, which is simply the ingrowing layer of epithelium.

In this report of a case of apparently true cholesteatoma of the frontal sinus, the chief points of interest would seem to be its rarity—for only one other case could be found and in that case the condition was probably of traumatic origin—and the probable origin of a condition of this type. None of the clinicians with whom I talked had observed a similar case, and the pathologists, while admitting this lesion was a true cholesteatoma, could suggest no other origin than a possible embryonal inclusion (which would put it in the general classification of dermoid or teratoma), traumatic inclusion or metaplasia. The pathologists seem to think that this explanation is not altogether unlikely and the condition is analogous to the metaplasia of tumors in other parts of the body. If so, it would probably take place owing to the irritation of chronic infection, which may have been present in the case reported, but if the lesion is produced in this way, why in the countless infections of the frontal sinus has it not been more frequently observed, as it is in the ear? Traumatic origin in this case may probably be ruled out by the history and the lack of any scar. The otolaryngologist thinks immediately of the process by which the epidermis invades the middle ear and the mastoid and seeks an analogous explanation, but in the ear conditions are different. From the skin of the external auditory canal, the epidermis passes inward through the perforation in the drum to replace the mucosa, and a continuous line of epidermal cells is present. In the case of the frontal sinus, if this reasoning held good, the epidermal invasion would have to start at the nasal vestibule and traverse the entire mucosal tract of the nasal chamber to and through the nasofrontal duct to the sinus, where if the implantation was successful desquamation and accumulation could proceed as in the aural condition. In doing this, however, it would seem that some trace of this invasion would remain in the nasal chamber, as shown by some change in the nasal mucosa. Such change was not observable.

There remains, then, the theory of fetal inclusion, and possibly this is the most satisfactory explanation after all. The inclusion must evidently be held causative for cholesteatoma found within the cranial cavity, so why not for cholesteatoma between the tables of the skull in the frontal sinus?

Rhinitis caseosa, a rare nasal condition having a somewhat similar symptomatology and pathologic picture, may easily be confused with cholesteatoma and may, indeed, be identical. This condition has recently been described by Meyersberg, Bernstein and Mezz<sup>3</sup> in an excellent article, with a report of a case, said to be the only one in the American literature.

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<sup>3</sup> Meyersberg, H., Bernstein, P., and Mezz, D. Rhinitis Caseosa. Analysis of Literature and Report of a Case, *Arch Otolaryng* 23 449 (April) 1936.

Since it was first described and named by Duplay in 1874, reports of cases and theories as to etiology have appeared from time to time in the European literature. While the symptomatology seems to be definitely established, the etiology is still much in doubt, except that the condition apparently accompanies suppurative disease of the sinuses. It has been called cholesteatoma, but there seem to be some apparently essential differences in the pathologic picture. It consists of a foul-smelling collection of flaky material, later forming a pultaceous, putty-like or cheesy amorphous mass in the nasal chambers and accessory cavities, which is easily removed, leaving a more or less normal mucosal lining. When the disease has been present for a long time, erosion of bone, with enlargement of the cavities, may take place, resulting in deformity of the parts or production of fistulous tracts. Different varieties of micro-organisms have been found present, but none has been thought to be the causative factor.

Skillein,<sup>4</sup> in 1921, reported a case of infection of the maxillary sinus, the description of which tallies with that usually ascribed to rhinitis caseosa, in which the infective agent was an aspergillus.

While some authors have attempted to identify rhinitis caseosa with cholesteatoma and while the symptoms often appear to be similar, the latter has certain characteristics thought to be diagnostic that are not found in the former. These are the basement membrane, or matrix, of squamous epithelium, the concentric arrangement of the desquamated cells and the presence of platelets of cholesterol between the layers. This contrasts with cylinder epithelial cells seen beneath the cheeselike masses of rhinitis caseosa and the amorphous character of the mass itself. If this distinction between the two diseases (if they are two) holds good, the case about to be reported would seem to be an instance of cholesteatoma, whatever its origin may have been, the various possibilities of which are discussed earlier in this paper.

One other possibility remains—traumatism. There was a history of a sledding accident thirty-five years before the patient came to the hospital, in which he sustained a deep wound between the left eye and the nose. The scar from this wound was not evident, but it is possible that at that time a piece of epidermis was displaced into the left frontal sinus or that a fistulous opening remained for a long enough period to permit some epidermization of the frontal sinus cavity, as in analogous cases of involvement of the mastoid. I think this possibility cannot be entirely ruled out, although the meager history of the accident does not specifically confirm it.

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<sup>4</sup> Skillein, Ross Hall. Aspergillosis of the Maxillary Sinus, *Tr. Am. Laryng. A.* 43: 180, 1921.

## REPORT OF A CASE

DeW M., a white man 51 years of age, was a truck driver. His previous history was without interest, with the following exception. At the age of 16, thirty-five years before he was examined, he was injured in a sledding accident, suffering a rather deep cut somewhere between the nose and the left eye, which displaced the eye downward and outward. From that time onward, he had left external strabismus, with diplopia when he was not wearing corrective glasses. While he was in the United States Army during the World War, this condition was aggravated because he did not wear glasses, but it was not essentially changed. Since 1917 and 1918 he had had repeated attacks of swelling, redness and pain in or about the left eye, which he attributed to a cold. This happened several times a year. He had been receiving compensation from the government for this since the war. Dr. Franklin stated that to his knowledge the patient had had some proptosis and swelling of the upper lid from time to time during the last sixteen years. He had not been subject to head colds, nasal discharge or headache.

The patient was first seen by me on Feb. 27, 1936, having been referred by his ophthalmologist, Col. C. P. Franklin, with the following history. For the last three weeks he had had a head cold, characterized chiefly by postnasal discharge. On February 18 he drove his truck through a hail storm with his head out of the window because of a frosted wind-shield. Six hours later there was sudden swelling of the upper left eyelid, with some pain. This received conservative treatment and fluctuated somewhat in size.

When he was first examined by me, the left eye was closed by edematous swelling of the upper lid and the soft tissues of the eyebrow and forehead. There was not much pain but some tenderness. The left eye was proptosed downward and outward, but the globe, as well as vision, appeared normal. Movements of the eyeball were markedly interfered with. The patient had had an occasional chill, with fever and frontal headache in the last few days. Little more of interest was found by examination. The nose was practically normal, only slight hyperplasia of the left middle turbinate, submerged and infected tonsils and some carious teeth being noted.

On February 28, the patient was referred to my dispensary in the Graduate Hospital, where Dr. Edmund Spaeth was asked for an ophthalmologic consultation. A diagnosis of retrobulbar abscess was made, and the patient was admitted to Dr. Luther Peter's ophthalmologic service. Roentgen ray examination by Dr. Karl Kornblum was reported as follows:

"There is a large cranial defect, approximately 4 cm. in diameter, in the left frontal region. This involves the frontal bone, the superior border of the orbit, the anterior part of the roof of the orbit and also the left frontal sinus. Within this defect there is a shadow of irregular calcification, which may be due to regeneration of osseous tissue or to a calcified plaque on the dura. The left frontal sinus shows a marked opacity, possibly due to a recent infection. The left maxillary sinus shows evidence of chronic thickening of the mucous membrane."

Immediately on admission the orbital abscess was drained by Dr. Spaeth by an incision through the upper lid. About 1 ounce (30 cc.) of yellow-green pus was evacuated. The abscess extended deeply behind the bulb. There was a fistulous opening into the left frontal sinus through the orbital ridge, the bone of which appeared to be necrotic and movable. A culture, which later was reported as showing *Staphylococcus albus-haemolyticus*, was taken, and a fragment of bone from the floor of the frontal sinus was sent to the laboratory. The report on this

was as follows "Sections from this tissue showed fragments of bone and fibrous tissue. In the latter there was a 'sheet' of squamous epithelium, which was not a tumor, and the soft tissues were infiltrated with leukocytes" (E Case)

During the next week the abscess continued to drain through the incision in the eyelid and the massive tumefaction receded. The headache was gone, and temperature, pulse and respiration were normal, as were the blood and urine. The report of examination on March 2 was "Vision 5/9 in the left eye. Mobility has returned in all directions, except for slight impairment of upward movement. The vessels of the fundus are still markedly engorged."

On March 6, the patient having been transferred back to my service, the area of the left frontal sinus was investigated, with anesthesia induced with tribromethanol in amylene hydrate. Roentgenograms on March 2 apparently showed a loss of most of the floor of the left frontal sinus, as well as of the external wall and, in addition, a large erosion cavity lateral to the sinus with no internal table. These findings were confirmed at operation. A large part of the floor of the sinus was missing, and the orbital ridge was largely sequestered and movable. The external wall of the sinus was missing in part, and the remainder was thin,



Fig 1—*A*, roentgenogram before operation. The right side appears on the left of the photograph. Note lateral extension due to erosion. *B*, roentgenogram before operation. Note the erosion cavity with exposed dura.

soft and infected. The cavity of the sinus was small, with the internal wall intact, but lateral to the true sinus cavity was another, continuous with it, with no dural plate but with the outer wall intact. Beneath this cavity, which extended to above the outer canthus and upward about 2 cm, the exposed dura was much thickened from chronic inflammation. The interior of these combined cavities was filled with a whitish-gray mass, which shelled out easily, almost intact. It was found to be arranged in concentric layers and was similar in appearance to the cholesteatoma so frequently found in chronic disease of the mastoid, except that there was no offensive odor. This is also lacking in some cholesteatomas of the mastoid. After thorough removal, it was thought that a thin and unhealthy matrix was present. The opening of the nasofrontal duct was firmly plugged by one or two small polypi. On removal of these, the duct appeared to be of ample caliber for drainage, and as the mucosa looked healthy, no further attention was paid to it. The wound was completely sutured, with a drain through the fistula in the upper lid, and compression was applied to effect obliteration of the sinus if possible. This was facilitated by the absence of a large part of the orbital ridge.

The culture taken at this time was reported as showing a nonhemolytic strain of *Staphylococcus albus*. The laboratory report on the material removed from the sinus was "The material contained many cholesterol crystals and hematinized epithelium. The bone was dense but did not show any epithelium attached. The diagnosis is cholesteatoma."

The remaining history of the case is commonplace. The sinus cavity continued to drain decreasing amounts through the fistula in the eyelid until the twelfth postoperative day, when drains were removed. At this time the anterior third of the middle turbinate was removed to facilitate nasal drainage, which thereafter came only through the nose. The fistula was reopened two or three times in the ensuing three months to release small collections of serum after discharge through the nose had ceased. All sutures had been removed by the fourth day after operation, the patient was up and about without symptoms, the edema was rapidly disappearing, and he was able to open the eye voluntarily. There appeared to be no diplopia. During the entire postoperative course he was afebrile and was without symptoms except those local to the wound.

He was last seen early in May 1937. The frontal sinus was well obliterated, and there was no inflammation or discharge either externally or intranasally. Movements of the eyelids were normal, and the attending ophthalmologist, Dr



Fig 2—A, the patient two days after operation. Note the proptosis of the left eye. B and C, the condition five days after operation. D, the patient three weeks after operation.

C. P. Franklin, reported that vision was normal and that the proptosis had almost disappeared. So far, there has been no recurrence of the cholesteatoma, and I think that I may feel fairly well assured that it has been eradicated.

After this case report was written, Dr. Fletcher Woodward, seeing my title in the program, forwarded to me the notes of a case of his and authorized me to add them to mine. The discovery of this case of Dr. Woodward's removed from my mind the last doubt as to the correctness of my diagnosis, for Dr. Woodward is a very intelligent and careful observer.

Dr. Woodward's notes are as follows:

*History*—Mrs. I. C., aged 27, was admitted to the hospital on June 14, 1926, and was discharged on July 16, after thirty-two days in the hospital.

Chronic cough, pain in the chest, shortness of breath, nervousness and frontal headache on the right side had been noted for nine months.

*Present Illness*—Severe sudden pain developed over the right eye seventeen days before the patient's admission, with gradual swelling, in two days the eye was completely shut, the pain continued and no nasal discharge was noted, the

eye remained swollen shut for seven days. For the next six days there was a discharge from the nose, pain and swelling subsided and the patient was fairly comfortable, then pain and swelling returned and increased during the two days before admission.

*Examination*—There was a round fluctuant swelling 2 by 2 cm over the right frontal area, the skin was reddened, with considerable chemosis of the right upper lid. The eye was swollen shut, with the globe in its normal position but fixed, vision was 20/100. Examination otherwise gave negative results. The maxillary and the left frontal sinus were clear on illumination.

Roentgenograms were made of the sinuses on June 15, 1926. There was apparently a clouding of both frontal sinuses. There was a large shadow of decreased density in the right frontal sinus, which encroached on the orbit, causing the periosteum to be stripped up at that point. Owing to the decreased density, a mucocoele was suspected.

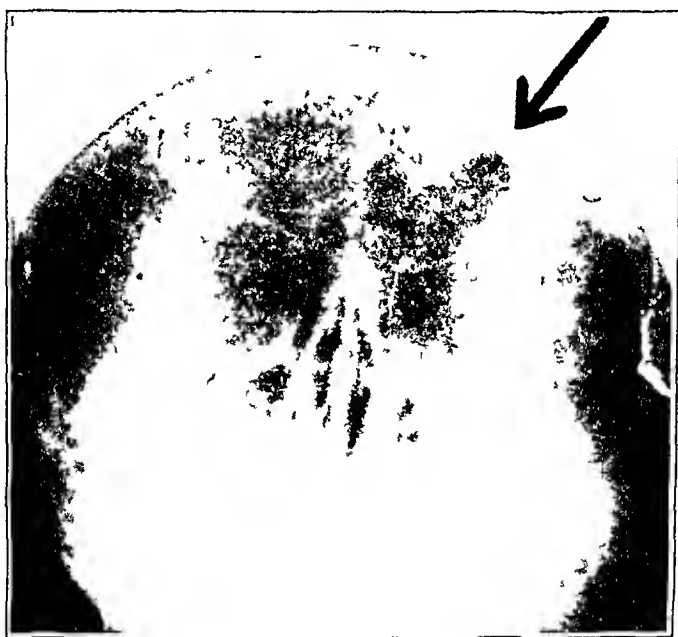


Fig 3—Roentgenogram of Dr Woodward's patient before operation. Note the erosion cavity pointed out by the arrow.

*Operation*—Sinusostomy of the right frontal sinus was done by the external approach on June 17. With ether anesthesia the usual incision was made through the brow and down to the inner canthus. The periosteum was reflected from the roof and the inner wall of the orbit, and the floor of the right frontal sinus was removed with a punch forceps. Free pus was encountered on entering the sinus, and considerable necrotic membrane and thick pus were removed. Lying free in the sinus was a mass of cholesteatoma about 2 by 3 cm. It was identical with similar masses encountered in the mastoid, being composed of layers of white and glistening epithelium. After the sinus was cleaned, it was noted that the posterior wall was necrosed away and a large dural exposure covered with granulations was found. There was also necrotic perforation of the anterior wall, with an overlying subperiosteal abscess.

After the sinus was carefully cleaned, a rubber tube drain was inserted through the anterior perforation by making a counter incision through the skin. The drain was then passed through the frontonasal opening into the nose. The tube was perforated at a point within the sinus, and the wound was closed in the usual manner.

*Postoperative Course*—The course was uneventful. A solution of sodium hypochlorite was injected through the tube every four hours for several days, then the tube was removed and a new rubber tube drain was inserted into the sinus through the anterior perforation and left in for two weeks.

On June 23 the clips were removed, the incision was healed and the drain still in situ, 2 cc of a solution of sodium hypochlorite was injected daily.

On July 1 the tube drain was removed and the sinus was clear.

On July 16 the patient was discharged, the wound was healed, with no deformity.

Culture showed *Staph. albus*. The urine was normal, and the Wassermann reaction was negative.

The patient did not have any fever, and the course was entirely uneventful. The patient has not been seen since her discharge from the hospital. A follow-up letter sent on May 5, 1937, has not been answered at the time of writing.

*Pathologic Report*—Pathologic examination was done on June 17. Macroscopic inspection showed several pieces of tissue, one surface of which was white and glistening, the other surface rough and pink.

Direct microscopic examination showed blood, pus, numerous collections of horny cells and a number of cholesterol crystals.

Microscopic sections showed a homogeneous and partly fibrillar structure.

The diagnosis was cholesteatoma.



# NASOPHARYNGEAL ABSCESES AND CYSTS

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My interest in nasopharyngeal abscesses and cysts was aroused two years ago, when B M Kully<sup>1</sup> reported 88 cases. I then recalled a similar article by Yankauer,<sup>2</sup> published in 1929, reporting 155 cases, and since I could not recall having observed similar conditions, which are apparently so common, I began to wonder why this was so. The answer was soon obvious when I realized that I had not really looked for them, and I think the reason I had not looked for them was also obvious, for there have been only four articles and four reports of single cases in American journals, and only three of these articles and one case report were published in the past twenty years.

Dorrance<sup>3</sup> in 1931 gave a rather complete historical survey and listed forty-four references in his bibliography. Kully listed fifty-six references, the majority of which were to articles in foreign journals which appeared prior to 1917.

It is this dearth of articles on a common condition, which is readily diagnosed and treated and of which the symptomatology is definite, that leads me to bring it to attention, with a summary of the literature and of my 14 cases, 12 of them observed in the past two years, since my interest was aroused.

In the consideration of these conditions, one must first eliminate abscess due to trauma, suppuration of the petrous apex or the lymph glands, degeneration cysts, dermoid cysts and cysts of branchiogenic origin as well as meningoceles and encephaloceles, limiting the discussion to infected retention cysts of the adenoid tissue or of the pharyngeal bursa.

There has been much controversy as to the embryologic origin of the pharyngeal bursa, but Dorrance's review of the literature in regard

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Read at the Forty-Third Annual Meeting of the American Laryngological, Rhinological and Otolological Society, Inc., Atlantic City, N J, June 4, 1937

1 Kully, B M Cysts and Retention Abscesses of the Nasopharynx. A Report of Eighty-Eight Cases, *J Laryng & Otol* **50** 317-328 (May) 1935

2 Yankauer, S Nasopharyngeal Abscess. A Report of One Hundred and Fifty-Five Cases, *Tr Am Acad Ophth* **34** 364-375, 1929

3 Dorrance, G M The So-Called Bursa Pharyngea in Man. Its Origin, Relationship with the Adjoining Nasopharyngeal Structures and Pathology, *Arch Otolaryng* **13** 187-224 (Feb) 1931

to this was rather complete, so I shall summarize his historical survey as follows

In 1838 Rathke described his pouch as the embryonic pharyngeal opening of the craniopharyngeal canal

In 1842 Mayer first described in man an invagination of the pharynx that is supposed to have been the structure subsequently called the bursa pharyngea

In 1877 Seessel described an invagination or pocket lower down in the pharyngeal wall, which was later studied by Nusbaum, who concluded that in the main it pertains only to the embryo and that it is of little or no importance

In 1882 Froriep stated that the bursa pharyngea is found at the site of the attachment of the notochord to the primitive pharyngeal wall

In 1885 Tornwaldt drew the attention of clinicians to the bursa in a publication in which he held that disease of the bursa is responsible for many systemic disturbances, though perhaps in some of his cases the lesions were pocketings of the pharyngeal tonsil

In 1886 Trautmann called attention to a deepened furrow embedded between the ridges of the pharyngeal tonsil, and physicians now know that pathologic adhesions here can produce a cystlike cavity

The discussion of these conditions went on for many years, and notable among the many discussers were Schwabach, Killian, Gradenigo and von Lushka

Dorrance said

The term bursa identifies a closed sac lined with endothelium. While the so-called bursa pharyngea is not a closed sac nor of mesodermic origin, long usage justifies the application of the term. The term bursa pharyngea designates a sacklike depression in the posterior wall of the nasopharynx just above the uppermost fibers of the superior constrictor muscle and usually extends upward and backward toward the occipital bone which it sometimes reaches with its apex. It is a well marked structure in the human embryo, although it seems to be rare as a distinct structure in the adult.

His conclusions in part were

- 1 A true bursa pharyngea in adults is an independent structure and is not to be regarded simply as the median recess of the pharyngeal tonsil

- 2 It does not develop from Seessel's pocket

- 3 It does not develop from Rathke's pouch

- 4 A true bursa pharyngea occurs somewhat frequently in man during embryonal life, it takes its origin from adhesions of the notochord to the pharyngeal entoderm

- 5 It is probable that the bursa in adults represents persistence of the embryonal bursa and may be the seat of inflammation and cyst formation

Yankauer confirmed the frequency of these conditions in his paper in 1929 and reported 155 cases. He claimed, however, that the involvement was due to suppuration in the remnants of adenoid tissue and not in the bursa pharyngea. Two thirds of his patients were from 20 to 40

years of age, and 93 per cent of them had not had their adenoids removed. The associated symptoms were postcervical adenitis and postnasal discharge in 66.5 per cent, occipital headache or pain in the back of the neck in 68 per cent, otalgia in 15 per cent and focal disease in 5 per cent. He opened the lesions under direct vision and removed the excess lymphoid tissues with punch forceps and then painted the area with a 20 per cent solution of silver nitrate. His results were uniformly good, and otolaryngologists are indebted to him for again bringing these conditions to their attention after a lapse of many years. However, I feel that he was in error in attributing practically all of them to abscesses of the recessus medius of the pharyngeal tonsil.

In 1928 Hagens<sup>4</sup> reported the occurrence of a typical bursa pharyngea in a man 70 years of age, studied post mortem. The cavity was 11 by 7 mm and contained a cheesy mass of acellular material. An ostium was noted at the dependent portion, and microscopic sections showed it to be lined with cuboidal epithelium. The wall of the sac was composed of dense connective tissue, sinusoidal vessels and well developed vessels. Small lymphocytes and plasma cells were noted throughout and also several glands and lymph follicles.

Kully in 1935 reported 88 cases of cyst and retention abscess of the nasopharynx, observed in a six year period, and stated that the scarcity of reports is due to failure in comprehension and diagnosis rather than to the rarity of the condition. He further stated that there has been much confusion in the literature in the use of the terms cyst and retention abscess. Strictly speaking, the so-called retention abscess of the nasopharynx is not an abscess. It represents an inflammatory closure of the mouth of an adenoid recess or of the pharyngeal bursa, with retention of secretion, bacteria, cells and other inflammatory detritus. As the cavity dilates, owing to the accumulation of secretion, it partakes of the nature of a cyst, but on microscopic section there may be few polymorphonuclear cells and a definite cyst wall. This condition should be described as an infected retention cyst. In sixty-two of his cases the lesion was of this type. He further stated:

From a clinical view point, I have classified as retention cysts of the adenoid those which were definitely surrounded by adenoid tissue and whose cavities could be entered by separating the folds with a probe. Cysts with a smooth surface without evidence of adenoid folds are regarded as originating in the bursa. This classification is arbitrary and subject to error.

The cardinal symptoms presented by his 88 patients were postnasal discharge, chronic pharyngitis and laryngotracheitis in 54.5 per cent, enlargement and tenderness of the posterior cervical glands in 30 per cent, frequently associated with stiffness and rigidity of the muscles of the posterior cervical region, occipital headache in 14 per cent, otalgia

<sup>4</sup> Hagens, E. W. Cystlike Cavity in the Nasopharynx, Arch. Otolaryng. 8: 420-423 (Oct.) 1928.

in 0.6 per cent and tinnitus and moderate deafness in 0.8 per cent, a few had persistent fever or focal disease, and 25 per cent had no symptoms, the condition being discovered in a routine examination.

A summary of my 14 cases reveals the following. All the lesions occurred in young adults. Four of them were retention abscesses of the median cleft of the pharyngeal tonsil. Ten were retention abscesses of the pharyngeal bursa and presented on inspection a smooth bulging surface, yellowish or white, situated high up in the nasopharynx and usually a little lateral to the midline. They were from 1 to 2 cm. in diameter, and their retained secretions were under sufficient pressure to produce a taut anterior surface. Postnasal discharge, sore throat and cough were the symptoms in 4 cases, deafness and tinnitus in 5, post-cervical pain and adenitis in 1, otalgia in 3, a sense of soreness in the nasopharynx in 3 and focal disease, with no localizing symptoms in 1. The last-mentioned case was perhaps the most interesting of all in that the patient was a student who had been forced to leave school because of persistent chorioretinitis. Most careful search for foci of infection had given entirely negative results in two medical centers. My examination likewise gave negative results, except for a definitely infected bursa pharyngea, which was opened with a punch forceps. Cultures showed hemolytic and nonhemolytic staphylococci, hemolytic and nonhemolytic streptococci, *Streptococcus viridans* and *Micrococcus catarrhalis*. An autogenous vaccine was made and used. After operation and treatment with the vaccine the condition of the eye rapidly cleared, and the patient has been able to resume his work.

The diagnosis is readily made by examination with mirrors, provided sufficient time and mirrors of various sizes and angles are used. The nasopharyngoscope is of no value, since its blindspot covers the area where these conditions arise. When such a condition has been noted by posterior rhinoscopy, it can be further studied by anterior rhinoscopy, and by the use of a probe, under direct vision, much additional information can be obtained.

The treatment has been the surgical removal of the anterior wall with a punch forceps, working either through the mouth under direct vision or through the nose. If the abscess is definitely located, the forceps can be placed through one side of the nose and inspection carried out through the other side and with a postnasal mirror. Direct inspection is aided by the Yankauer nasopharyngeal speculum.

There have been no recurrences in this series in the period in which the patients have been followed.

The origin, pathology, frequency and symptomatology have been well covered in the articles referred to in the footnotes. I have quoted them to a large extent and have merely attempted to summarize them, report a small group of cases and direct attention again to a much neglected condition.

# SUPPURATION OF THE PETROUS PYRAMID

## SOME VIEWS ON ITS SURGICAL MANAGEMENT

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NEW YORK

Suppuration of the petrous pyramid is a serious complication of otitis media. By suppuration of the petrous pyramid is meant an infection of some part of the cellular structure surrounding the cochlea and the semicircular canals which usually localizes in the apical area as empyema. Thus the term apicitis or suppuration of the petrous apex is used. According to my figures, this condition occurs approximately once in every 300 cases of otitis media.

A majority of patients with this complication recover without resort to surgical intervention. In a small percentage of cases the disease does not localize but spreads by way of the vascular channels, causing fatal meningitis. This is usually a nonsuppurative lesion. No means of combating this type of the disease is available. The remainder of the cases constitute the 30 or 40 per cent in which the condition becomes a surgical problem.

The petrous portion of the temporal bone is a pyramidal structure having a basal and an apical portion and three surfaces. The base consists of the medial aspect of the middle ear and the mastoid cavity. It contains the cochlea anteriorly and the semicircular canals posteriorly. Adjacent to these structures are to be found tracts of cells which usually extend along their perilabyrinthine course into the apex or may terminate before they reach this region.

The apical area is rather truncated and does not constitute a true apex. It extends from the internal auditory meatus to the lateral aspect of the body of the sphenoid bone. Medially the apex is in relation to the lacerated foramen, which transmits the internal carotid artery, and antero-inferiorly, to the horizontal portion of the same artery in its bony canal.

The anterior surface of the petrous pyramid extends from the eminentia arcuata, the eminence above the arch of the superior semicircular canal, to the lateral aspect of the body of the sphenoid. This surface is in contact with the dura of the middle fossa (temporal lobe), which is especially adherent in the region of the apex, where the fibers of the gasserian ganglion are attached.

The posterior surface is in contact with the cerebellar dura and extends from the lateral prominence of the posterior semicircular canal to the apex. This surface presents the ductus endolymphaticus just beyond the posterior canal. More medially is situated the internal auditory meatus, which transmits the seventh and eighth cranial nerves.

The inferior surface begins with the vertical portion of the carotid canal and extends to the foramen lacerum. This surface consists principally of a quadrilateral plate of bone on which rests the horizontal portion of the internal carotid artery. To this plate of bone are attached the tendon of the levator veli palatini muscle and the pharyngeal aponeurosis. This plate of bone is part of the roof of the retropharyngeal space.

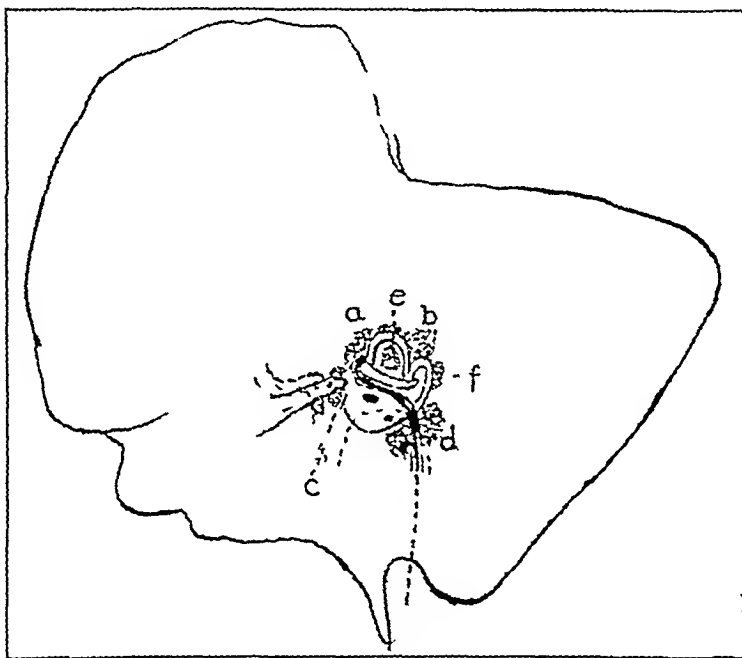


Fig 1—A semidiagrammatic reproduction of the structures of the middle ear and the mastoid in relation to the base of the petrous pyramid. Areas marked *a*, *c*, *b*, *f*, *d* and *e* indicate where the beginning of tracts of softened bone leading into the apex may be found. This figure is reproduced from a previous issue of the ARCHIVES (22.70 [July] 1935).

Owing to its complex structure, the bone may become involved in different locations and cause symptoms according to the structures implicated. Two principal locations of the disease are distinguished—superior and inferior. The superiorly placed infection is evidenced in the roentgen study by a break in the superior line, or roof, of the apical cavity. This indicates an extrapetrosal lesion, which is really a large epidural abscess. This lesion is harmless from the standpoint of the production of future meningitis or abscess of the brain for varying lengths of time. There are many who believe that one can wait until there is definite evidence of meningeal irritation before sur-

gical treatment of the petrous apex is done I believe this to be perfectly safe in a majority of instances I should prefer, however, to rely on the roentgen findings and the clinical symptoms, with the expectation that surgical operation would be performed long before meningeal irritation occurred

In the inferiorly placed infections the disease has not reached the roof of the apical cavity but the pus has accumulated in its inferior portion This is because the osteomyelitic process which preceded the

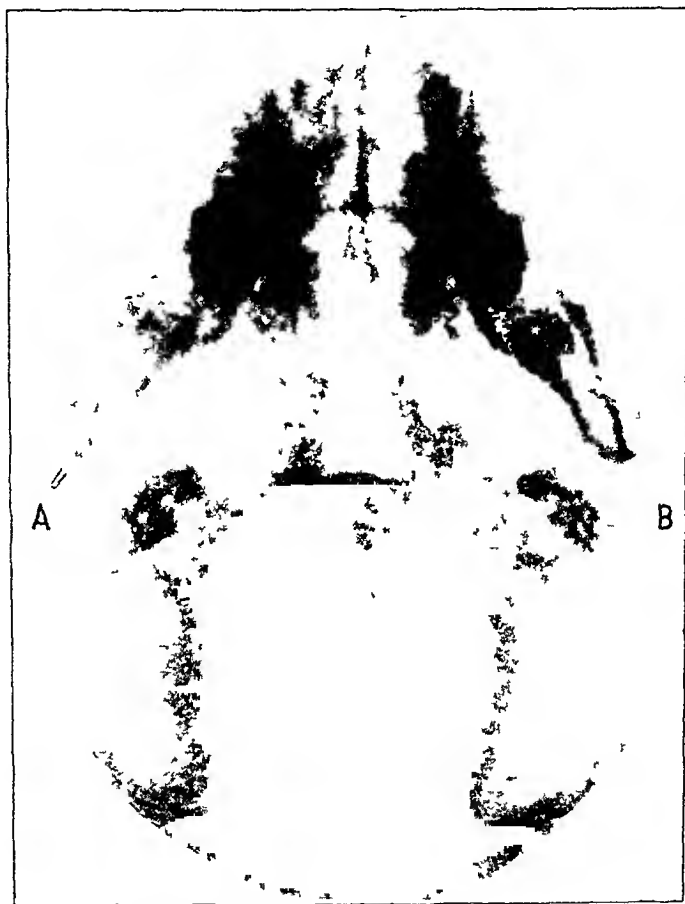


Fig 2—Film taken in the base, or mentovertical, position Note the loss of detail of structure in the right apex (*A*) as compared with the normal side (*B*)

empyema was confined to the infralabyrinthine, or hypotympanic, portion of the bone When such is the case, the roentgenograms taken in the Stenver position or in the supero-inferior axis show no break in the continuity of the line of the roof of the apex, but the film taken in the base position gives evidence of loss of detail of the structures in the apical area This combination of roentgen findings indicates that the disease is in the basal portion of the petrous apex When the disease is so located, the film taken in the Stenver position may show

partial or complete absence of detail of structure in the apical area, but the line of the roof will be intact

The symptomatology of this disease is well known and understood. It is based on the location and the activity of the infectious process. The patient may complain of ocular pain or pain in the forehead with both superior and inferior infection. He is much more likely to complain of headache with the superiorly placed infection. In the inferiorly placed disease the quadrilateral plate of bone on which the carotid artery rests becomes involved. When pus is trapped under pressure in the carotid canal or when there is acute congestive inflammation of this structure, the carotid sympathetic nerves may become affected, causing Horner's syndrome. Recently I observed a patient who pre-

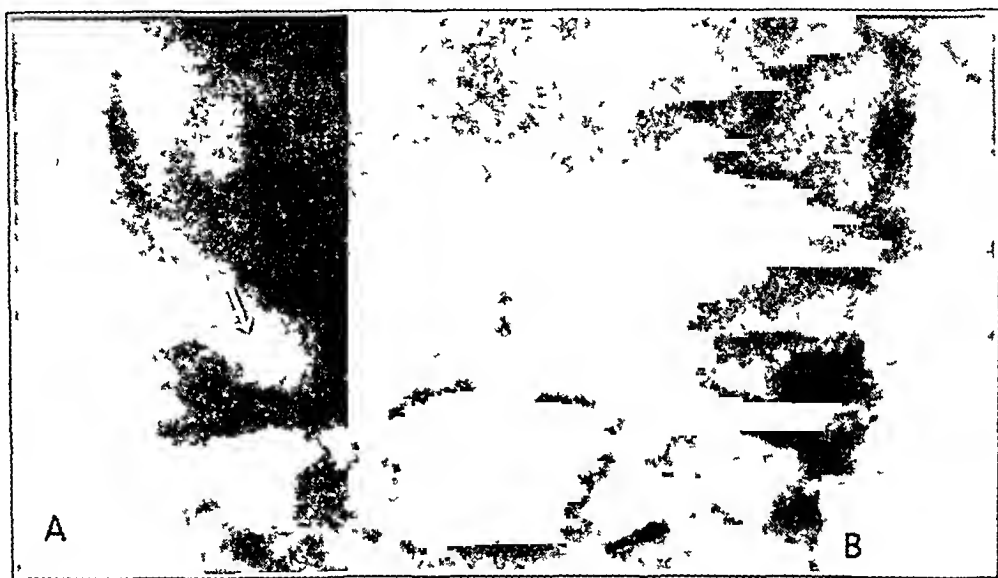


Fig 3—Film taken in the Stenver position. Note the right side (A), in which the line of the roof of the apex is gone, as compared with the other side (B), which is normal. This figure is reproduced from an earlier issue of the ARCHIVES (22 80 [July] 1935)

sented this syndrome. In addition to causing Horner's syndrome, disease of the carotid canal will cause pain on motion of the temporomandibular joint, which is localized to the innermost parts of the glenoid cavity.

The discharge may be profuse, moderate, scanty or absent. In many cases no discharge from the middle ear is present but there is a moderate or profuse discharge from the mastoidectomy wound. A relatively increased pulse rate is a symptom of importance. In the type of suppuration of the petrous pyramid requiring surgical treatment the pulse rate is elevated out of proportion to the temperature.

Because of the variety and number of operations which have been advocated for the cure of empyema of the petrous apex, a great deal



of confusion exists in regard to the management of this condition. One should aim to simplify the treatment as much as possible and to maintain a conservative attitude<sup>1</sup>. Conservatism is important in all surgical procedures, but especially so in those involving the temporal bone, in which the hearing is sacrificed by radical procedures. Therefore, whenever possible radical mastoidectomy should be avoided. Resection of large areas of normal tissue is unnecessary in most cases. Procedures, such as those of Ramadier and Lempert, which entail radical mastoidectomy and interference with the function of the temporomandibular joint should be considered only as a last resort.

When one is treating this condition, it is important that one know whether the infection is in the upper or the lower part of the apex. This information can best be obtained by means of roentgen study together with an interpretation of symptoms which suggest one location or the other. In the superiorly placed infection simple mastoidectomy is first performed or the previous mastoidectomy wound is revised. The superior semicircular canal must then be skeletonized, with exposure for purposes of probing the region within the arch and anterior and posterior to the canal. The probing is done to detect a tract of softened bone leading into the apex. Probing such a softened tract will liberate the pus which is locked in the apical area in many cases.

If a tract of softened bone is not found, the apex should be approached by way of the anterior surface<sup>2</sup>. This entails elevation of the temporal lobe after its adequate exposure. Before this approach is undertaken, a copious removal of the spinal fluid is carried out by either lumbar or cisternal puncture. This lessens the intracranial pressure and enables one to elevate the temporal lobe more readily. A section of the squamous portion about the size of a silver dollar is removed. This extends from the sinodural angle posteriorly to a point  $\frac{1}{2}$  inch (1.25 cm) anterior to the zygomatic root. In addition, the tegmen of the mastoid is resected. The temporal lobe is now elevated, with the posterosuperior border of the petrous pyramid always in view. Four landmarks are utilized in this procedure—first, an elevation, the eminentia arcuata, directly above the superior semicircular canal, then a depression, the fossa subarcuata, then an elevation, the roof of the internal auditory meatus, and last, a depression which constitutes the roof of the apical cavity on which rests the gasserian ganglion. When the roof of the apical area is encountered, a defect is found which was being corked by the dura. As soon as this defect is met, there occurs a gush of pus from the apical cavity.

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1 Myerson, M. C., Rubin, H. W., and Gilbert, J. G. Considerations on Suppuration of the Petrous Pyramid, *Arch. Otolaryng.* **22**: 62 (July) 1935.

2 Myerson, M. C., Rubin, H. W., and Gilbert, J. G. Improved Operative Technic for Suppuration of the Petrous Apex, *Arch. Otolaryng.* **19**: 699 (June) 1934.

If the operator should decide that uncapping of the carotid canal and visualization of the floor and the posterior wall of the apical cavity are necessary, the approach just outlined will be found ample. The exposure afforded by this operation is both satisfactory and harmless. It can be performed without injury to the dura, the middle meningeal artery or any other structure. Complete apicectomy, as described by Lempert,<sup>3</sup> can be performed by means of this approach without recourse to destruction of the mechanism of the middle ear and without mutilation of the temporomandibular joint.

I do not agree that elevation of the temporal lobe entails the risk of tearing the dura. Nor am I in favor of extensive operations which expose the carotid artery and destroy the integrity of the temporomandibular joint as a routine. That portion of the carotid artery which lies in the petrous bone and is thin has a wall the structure of which is like that of a vein. My attention was called to this several years ago by Richards.<sup>4</sup> It is possible that undue exposure of this portion of the artery may predispose it to the formation of aneurysm because of the lack of the support which nature has provided.

If the roentgen study and clinical signs and symptoms indicate an inferiorly placed infection, I concentrate my attention on the sub-labyrinthine area of the mastoid during the performance of a simple mastoidectomy. The area just below the posterior semicircular canal is carefully searched for the beginning of a tract of softened bone which leads into the apex. Another point from which a similar tract may be found is located just below the eustachian tube, between the cochlea and the carotid artery. A radical mastoidectomy is required to expose this region. I do not favor this procedure and see no necessity for it in the treatment of empyema of the petrous apex. A radical mastoidectomy sacrifices the hearing. This fact should be given serious consideration if the patient is a child.

If no tract of softened bone is found, it is perfectly safe to wait for possible erosion of the pus through the inferior surface of the petrosa and the formation of a nasopharyngeal abscess. If this does not occur and meningeal irritation makes its appearance, operation should be performed by means of a cervical incision for draining the apex inferiorly.<sup>5</sup> This operation is performed through an incision

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3 Lempert, Julius. Complete Apicectomy (Mastoidotympanoapicectomy), *Arch Otolaryng* **25** 144 (Feb) 1937.

4 Richards, John D. The Petrous Pyramid. Its Surgical Anatomy and the Technic of the Operation for Its Removal, *Am J Surg* **2**:11 (Jan) 1927.

5 Myerson, M. C., Blumberg, Ralph, and Rubin, H. W. A Proposed Operation for Osteomyelitis of the Inferior Aspect of the Petrous Pyramid, *Arch Otolaryng* **25**:373 (April) 1937.

along the anterior margin of the sternocleidomastoid muscle, the retro-pharyngeal space is exposed up to its roof, which is the inferior aspect of the area of the petrous apex. When this region is reached, the attachment of the levator veli palatini muscle and that of the pharyngeal aponeurosis to the quadrilateral plate of bone are identified. These attachments are scraped aside with an elevator, and the diseased quadrilateral plate of bone, which constitutes the floor of the carotid canal, is firmly probed. The bone is either softened or liquefied, so that it yields to the pressure of the instrument. Withdrawal of the instrument is followed by a gush of pus when pus is present.

When the infection is inferiorly placed and there is evidence on the roentgenogram of extensive destruction of the bony substance within the apical cavity, the operator should attempt to enter this cavity through any lead which the roentgenogram offers. This lead may be either anterior or posterior to the superior semicircular canal, or it may be below the posterior canal. All these locations can be exposed and attacked without recourse to radical mastoidectomy.

In conclusion, a simplified and conservative plan of management is offered for suppuration of the petrous pyramid which ends in apical empyema and requires surgical intervention. There is no justification for extensive, difficult and in some instances destructive operations in a great majority of cases. There is no need for a radical mastoidectomy in the treatment of empyema of the petrous apex, nor is there justification for operations, such as those of Ramadier<sup>6</sup> and Lempert,<sup>3</sup> which require extensive removal of healthy bone and which compromise the temporomandibular joint.

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6 Ramadier, J. Les osteites petreuses profondes (petrosites), Oto-rhino-laryng internat **17** 816 (Nov) 1933

# A METHOD OF DRAINING CEREBRAL ABSCESES

J M ROBISON, M D

HOUSTON, TEXAS

The purpose of this paper is to call attention to some of the more important physiologic and pathologic factors and principles underlying infection of brain tissue and to detail a method of treatment which in my hands has proved satisfactory. In an effort to do this I shall not go into the problems of etiology and symptomatology but shall confine my remarks to a brief summary of the operative and postoperative course in four cases chosen to illustrate three types of disease of the brain—traumatic disease, acute abscess and chronic abscess. I shall quote from textbooks excerpts which I think have a bearing on the method of drainage of abscess of the brain with which this treatise is concerned.

CASE 1—W. F. S., a man about 35 years of age, was injured on May 4, 1925, by a piece of 1 by 1 inch (2.5 by 2.5 cm.) lumber driven with considerable force between the eyes. Some eight hours later he was brought into the hospital, where examination showed marked edema of the eyelids and the surrounding soft tissues. There was compound fracture of both frontal sinuses and both ethmoid sinuses in the midline. Part of the bone forming these structures had been driven into the brain, causing a rent in the dura, 1½ inches (3.7 cm.) in length, from the cribriform plate toward the vertex, paralleling the longitudinal sinus and adjacent to this structure. Protruding through this laceration in the dura was about a tablespoonful (15 cc.) of cerebral tissue, in which were embedded dirt and fragments of bone.

At operation a complete removal of the outer wall of both frontal sinuses as well as of the anterior ethmoid cells was effected. The protruding brain tissue was excised at the level of the dura. By gentle probing several sizable fragments of bone were removed from a depth of 1 inch in the frontal lobe of the brain. After the pieces of bone which were found were fitted together, it was thought likely that some fragments remained in the brain tissue. The lacerated area of the frontal lobe was drained with a short strip of rubber tissue. Iodoform gauze was packed around the area of the dural decompression, and a wet dressing was applied. It was impossible even partially to close the rent in the dura owing to the proximity of the longitudinal sinus. The patient was in a semiconscious condition when he was operated on, but on the following day he was rational, his only complaint being headache. Three days later pus began to make its appearance through the opening in the dura. His headache increased in severity, and in another forty-eight hours he had symptoms of encephalitis. At that time the drain through the dura was changed to a perforated rubber tube. This did not relieve his symptoms, so, thinking that probably there were pieces of bone in the brain, which were causing this suppuration, I packed the lacerated area of the brain with a long strip of rubber tissue, using sufficient tissue to expand the

area, hoping in this manner to coax the bone to the surface. The following day the condition was markedly improved. In the next two weeks several small particles of bone came away, and the discharge almost ceased. Removal of the rubber tissue pack was begun at that time and was completed within the next two weeks.

This man was bothered with diplopia for about six months and then made a complete recovery, except that he suffered from headache when he became overheated or indulged in hard work.

CASE 2—F, a boy aged 12 years, came to the hospital complaining of headache. His left ear had been draining since he had scarlet fever in childhood. Examination showed destruction of the drum membrane and ossicular necrosis associated with cholesteatoma. A radical mastoidectomy was advised and performed.

At operation cholesteatomatous material was found filling the mastoid antrum. The dura over the antrum and the aditus had been exposed by the cholesteatoma and was covered with what appeared to be healthy granulation tissue. This pathologic decompression was enlarged to the normal dura. Convalescence was not remarkable, except that he still complained of some headache. He returned to his home, and ten days later I was called to see him. I found him in a semiconscious condition. He had many of the cardinal symptoms of an abscess of the temporal lobe.

At operation the decompression was enlarged and a small incision was made in the dura through an area of granulation tissue, which looked darker than its surroundings. A closed bayonet forceps was then introduced into the temporal lobe about  $\frac{1}{4}$  inch (0.6 cm), where it liberated a large amount of fetid pus containing a considerable quantity of gas. A perforated rubber tube was placed well into the region of the abscess.

This patient was rational a few hours later and continued so for four days. He then acquired symptoms of encephalitis. Examination showed the drainage tube apparently in good position, and there had been no change in the amount of drainage. At that time a speculum was introduced into the abscess area and a long strip of rubber tissue was packed into the abscess, enough being used to distend its walls.

By the following day this patient had lost his lethargy, and he was free from symptoms for four days. In this time the brain extruded most of the packing. Concurrently, there was a return of headache and drowsiness, which abated as soon as the abscess was packed again. The packing was completely removed six weeks after operation, and he made a complete recovery.

CASE 3—Mrs. P, aged 26, came to the hospital complaining of severe headache over the left side for the previous six weeks. Her left ear had been discharging for four months. A simple operation on the mastoid was advised and proceeded with immediately.

A large epidural abscess was present, covering the dura over the tegmen of the antrum and extending posterolaterally over the knee of the lateral sinus. The inner table of bone was removed until healthy dura was exposed. The dura was covered with apparently healthy granulation tissue.

On the day following operation this patient was free from symptoms and continued so for seven days. She then acquired marked headache and became semiconscious. Examination showed many of the cardinal symptoms of an abscess of the temporal lobe of the cerebrum.

At operation the decompression was enlarged, a small incision was made parallel to the vessels in the dura and a bayonet forceps was passed into the posterior part of the temporal lobe, where an abscess was entered and thick

greenish-yellow pus having no odor was evacuated. As the pus began to escape, I packed this abscess with a long strip of rubber tissue, using enough to keep the walls of the abscess distended.

The patient made an uninterrupted recovery, except that about the sixth post-operative day she began to have headache and aphasia began to return. It was found that the brain had expelled considerable of the rubber tissue. This was replaced, and she made a complete recovery.

CASE 4—N. D., a boy aged 12 years, was admitted to the hospital on Aug. 31, 1932, complaining of pain in the region of the left mastoid, headache and frequent chills followed by fever. Examination revealed that he was very sick. A diagnosis was made of acute mastoiditis on the left side superimposed on chronic purulent mastoiditis complicated by thrombosis of the sigmoid portion of the left lateral sinus and septicemia. At operation a cholesteatomatous mass was found, a radical mastoidectomy was performed and the lateral sinus was found to contain purulent fluid. The dura over the temporal lobe of the cerebrum in the region of the mastoid and the dura over the anterior surface of the cerebellum were very necrotic. The operative procedure was completed by resection of the left internal jugular vein and the placing of packs in the proximal and distal openings of the lateral sinus. Owing to the shocked condition of the patient, the lateral sinus could not be decompressed toward the torcular. After this operation he presented typical fulminating septicemia for seven days, the lateral sinus was then decompressed toward the torcular until free bleeding occurred from its lumen. After this procedure the symptoms of fulminating septicemia abated, but pulmonary infarction with a septic embolus occurred, which was followed by a pulmonary abscess. Postural drainage, numerous bronchoscopic drainages, repeated blood transfusions and other treatment corrected this condition. Owing to the large area of necrotic dura present, herniation of the cerebrum and cerebellum into the mastoid cavity occurred. Consequently, thirty-seven days after the operation on the mastoid a plastic operation was performed on the scalp of the region to cover and protect this brain tissue.

The patient apparently recovered completely from this illness. He returned to school and acquitted himself well in studies and athletic activities, being free from headache or other symptoms referable to his ear until four years and four months after the mastoidectomy, when he returned complaining of headache, diplopia and pain in his left ear. Questioning revealed that two weeks previous to his return he had a fainting spell and felt that something was wrong inside his head. He then began to feel tenderness over the left mastoid area, which was slightly hyperemic over the scar. Diplopia was present and both fundi oculorum showed papilledema. Owing to the herniation of the brain into the mastoid cavity, there was complete atresia of the external auditory canal. Pus was evidently present in the mastoid area. Accordingly, an incision was made through the scar from the mastoidectomy. Pus which had a slight odor was evacuated from the region of the tympanum. An opening was found through the dura over the temporal lobe of the cerebrum, through which pus was draining. Without any more evacuation of this pus than was necessary, two strips of rubber tissue about  $\frac{1}{4}$  inch (0.6 cm) in width and about 2 feet (60 cm) in length were packed into the cerebrum through this opening, as the pus which the rubber displaced escaped.

After this operation the headache, diplopia and papilledema persisted for three weeks. The rubber tissue was removed beginning about four weeks after operation, removal being complete six weeks after operation. Thereafter the patient

made a complete recovery At the time of writing he has been in school for two months and states that he is free from symptoms

The question naturally arises Was this abscess present during the four years of freedom from symptoms, or did it develop as an acute abscess just previous to his recent illness? This question is debatable, and I leave it to the reader's own conjecture

Any consideration of a method of treatment of infected brain tissue would not be complete without an explanation of how and why the procedure instituted relieved the pathologic condition and corrected the pathologic physiologic relations

For this purpose one can consider the brain a homogeneous mass suspended in a cavity filled with fluid This fluid is under a certain amount of pressure, which is opposed by the pressure in the arterio-venous system It also permeates along the blood vessels to the terminal capillary bed and even goes so far as to surround each nerve cell Wright<sup>1</sup> stated

As the arteries and veins enter and leave the brain substance they are surrounded by the perivascular spaces (of Virchow and Robin) which are continuous with the subarachnoid space and also with fine spaces which surround the nerve cells

Speaking of the cerebrospinal fluid, which he considered as a modified form of lymph, Cunningham<sup>2</sup> stated

The fluid which pervades the cerebral substance must have some exit, and it is not unlikely that it passes with the lymphocytes through cleftlike intercommunicating spaces in the adventitial coats of the blood vessels similar to those demonstrated by Bruce in the case of the spinal medulla and so reaches the pia mater and subarachnoid space, that is, it runs along the walls of the arteries, enters the meningeal lymphatics, and passes through them to the exterior of the cranium

These excerpts are quoted to bring attention to the close relation of the cellular components of the cerebral substance to the cerebrospinal fluid The fact that the entire capillary bed which permeates the cerebral tissue is itself surrounded by channels containing cerebrospinal fluid accounts for the marked effect which alteration in pressure on the capillary and cerebrospinal fluid system has on the nerve cells of the cerebrum

In cerebral abscess, unless the condition has progressed to the point of extensive necrosis or gangrene, there is rarely destruction of a great amount of brain tissue Rather, there is an accumulation of pus forming the abscess, surrounded by an area of compressed brain tissue, the tissue nearest the abscess being compressed most owing to the cerebritis sur-

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1 Wright, S Applied Physiology, ed 5, New York, Oxford University Press, 1934, p 335

2 Cunningham, D J Text-Book of Anatomy, ed 6, edited by A Robinson, Baltimore, William Wood & Company, 1931, p 1003

rounding the inflammatory area. This accounts for the aphasia associated with abscess some distance from the anatomic speech center. In this connection, however, one must bear in mind the tendency for the more highly developed functions, such as speech, to be affected under increased pressure before the more primitive functions such as voluntary motion.

After consideration of this balance of pressure between the cerebrospinal fluid and the extensive cerebral capillary bed, it is not difficult to appreciate the rapid and extensive transudation of fluid into the intercellular spaces which occurs when the intracranial pressure is quickly and markedly reduced, as in free incision of the dura or in turning down of a large dural flap. This sudden release of pressure in the

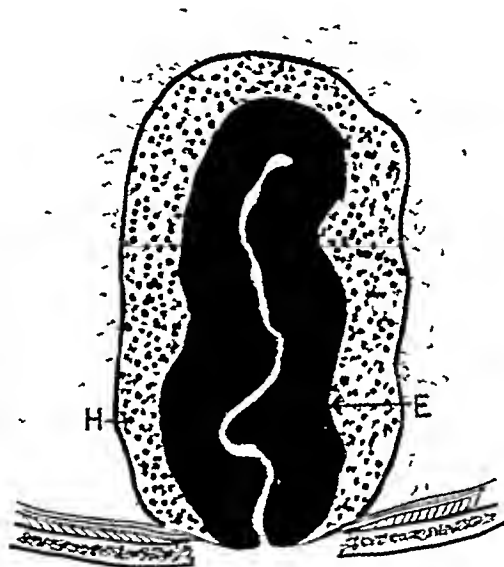


Fig 1—Diagrammatic illustration of a collapsed abscess showing how edematous brain tissue (*E*) fills the abscess cavity if the pus is not replaced with packing. This edema, if it is allowed to occur by sudden complete evacuation, leads to pocketing of infection and interference with the blood supply of the adjacent brain tissue and makes more difficult the proper placing of a drain. *H* indicates the area of hemorrhage and necrosis.

presence of marked cerebritis, such as accompanies abscess, results in an edematous multiplication of the volume of the brain tissue. The prevention of the formation of this edema in the wall of the abscess and also in the brain tissue adjacent to the abscess is one of the chief factors to be taken into consideration in the satisfactory treatment of cerebral abscess.

If in operation on a cerebral abscess particularly in the acute stage, a large incision is made in the dura and the abscess is freely evacuated, the edematous brain tissue immediately fills the abscess cavity (fig 1). This leaves no cavity or area in which to place a drain except the



edematous brain tissue. This closing in of the walls of the abscess leads to pocketing of infection, and since in the area of cerebritis surrounding the abscess the perivascular spaces are filled with lymphocytes and the excess fluid cannot be carried away, the nutrition of the brain substance is impaired and later necrosis ensues. This change in the area surrounding the abscess probably accounts for the symptoms, often fatal, which occur some days after the operative procedure.

The procedure which I have tried and found satisfactory is as follows:

The skull is removed from the dura over the area of the abscess, enough being taken away to allow the dura to bulge into the opening. The pressure of

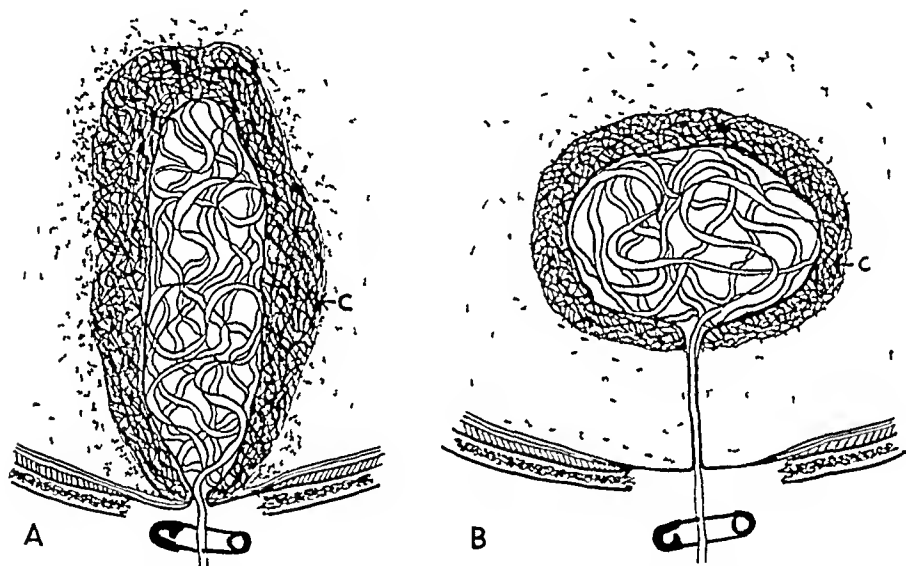


Fig 2—*A*, diagrammatic illustration of a cortical abscess packed with rubber tissue. The rubber tissue is packed into the abscess cavity while the pus is still in place, the amount of tissue used being determined by the amount of pus which escapes. *C* indicates the area of compressed brain tissue (cerebritis). *B*, diagrammatic illustration of a deep abscess packed with rubber tissue. This method is applicable to both cortical and deep abscess. *C* indicates the area of compressed brain tissue.

the brain against the dura around the margins of the bony defect precludes the possibility of pus entering the subdural space as it is drained from the abscess. In the center of the decompressed area a small incision is made through the dura parallel to any vessels present. A bayonet forceps is then passed into the abscess cavity. As soon as a little pus has escaped, a long strip of rubber tissue about  $\frac{1}{4}$  inch (0.6 cm) wide is packed along the bayonet forceps into the abscess cavity. As more pus escapes, more tissue is introduced, the amount used being determined by the amount of pus evacuated, the object being to fill the abscess cavity as nearly as possible with rubber tissue before the walls of the cavity collapse. The terminal end of the rubber tissue is then made secure (fig 2).

The advantages of this procedure are these 1 A sudden release of pressure on the walls of the abscess and the tissue surrounding the abscess is avoided This prevents edema, alteration of blood supply and nutritive changes in the wall of the abscess and the adjacent tissue 2 Pocketing of the abscess cavity is minimized, because the abscess cavity is retained as a cavity filled with rubber tissue instead of an area of edematous brain tissue 3 With this cavity still present but draining and the intracerebral pressure only slightly changed, the pressure forces the inflammatory products from the tissues surrounding the abscess into the area packed with rubber tissue, from which it may find an exit

In acute abscess formation in which some broken-down blood clots and necrotic parts of the wall of the abscess must be drained away, it may be found necessary to insert a short piece of rubber tubing along the rubber tissue to allow the more solid particles to come out This, however, usually is not necessary until several days after the abscess is opened

This rubber tissue is nonirritating The pressure in the cranium may tend to force it out, but this usually does not occur until several days after it is put in place, when a fairly well defined drainage tract has been established I have used an ordinary brain speculum shaped like a nasal speculum with long blades to repack the area The rubber tissue has been left in place for a period depending on the symptoms of the patient and the size of the abscess It has been removed gradually, from four to six weeks being sufficient for its complete removal

# MENINGITIS DUE TO A HEMOLYTIC STREPTOCOCCUS

REPORT OF TWO CASES WITH RECOVERY AFTER THE USE OF  
PRONTOSIL AND SULFANILAMIDE

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Several recent reports<sup>1</sup> of cases of meningitis due to a hemolytic streptococcus have included a brief but satisfactory review of the literature, with the number of reported recoveries. In a fairly large number of cases we have observed until recently but one recovery.

This occurred several years ago and followed the use of antistreptococcus serum. We did not think the case of sufficient general interest to be reported. However, the recovery of two consecutive patients recently observed is so unusual in our experience that we are briefly reporting their cases.

## REPORT OF CASES

CASE 1—A youth aged 13 was admitted to the Meadowbrook Hospital on April 3, 1937, with a history of pain in the right ear beginning seven days previously. A myringotomy had been done on March 30. On his admission there was a profuse serous discharge from the aural canal, but no other sign of mastoiditis. The right lateral rectus muscle was paralyzed. The neck was moderately rigid, the Kernig and Babinski signs were positive, and the superficial reflexes were inactive. The spinal fluid was cloudy, with 1,850 cells. The blood count showed 26,800 white cells, with 88 per cent neutrophils. The blood culture was negative.

On April 5 a simple mastoidectomy was done. The mastoid cells were filled with serous exudate throughout the process. There was no destruction of bone. In the angle between the middle fossa and the knee of the lateral sinus pus was encountered and a perisinuous abscess was uncovered. The sinus wall was necrotic.

The temperature became normal in two days. A transfusion of 500 cc of citrated blood was given on April 13. The wound healed by primary union. The

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Read at a meeting of the Medical Society of the County of Nassau, N Y, April 27, 1937.

1 Anderson, E D Hemolytic Streptococcus Meningitis, J A M A **108** 1591-1592 (May 8) 1937. Schilling, R Otitic Meningitis, Arch Otolaryng **25** 455-464 (April) 1937. Coonley, F Streptococcus Meningitis, New York State J Med **37** 573-576 (March 15) 1937. Schechter, S P Otitic Streptococcal Meningitis with Recovery, Arch Otolaryng **25** 266-271 (March) 1937. Dintenfass, H Streptococcal Otitic Meningitis with Recovery, *ibid* **25** 311-313 (March) 1937.

patient was discharged with a healed wound and a dry middle ear on April 23, 1937. There was still moderate diplopia, which was worse when the eyes were rotated to the right.

Prontosil<sup>2</sup> was given as follows:

April 5	20 cc intraspinally
April 6	20 cc intraspinally and intramuscularly
April 6, midnight	20 cc intraspinally and intramuscularly

Sulfanilamide was given in doses of 15 grains (0.97 Gm) every four hours from the day following admission to April 9, when the dose was cut to 10 grains (0.69 Gm) every four hours on account of cyanosis. On April 14 it was omitted for twenty-four hours, and administration was resumed on April 15 with 5 grains (0.32 Gm) every four hours. It was discontinued on April 19.

TABLE 1—Findings in the Spinal Fluid

Date	Polymorphonuclears,		Culture
	Cells	Percentage	
4/4	1,850	53	Hemolytic streptococcus
4/5	1,890	61	Hemolytic streptococcus
4/6	2,050	66	Negative
4/6	5,200	75	Negative
4/7	1,782	75	Negative
4/8	280	32	Negative
4/10	100	12	Negative

CASE 2—A boy aged 4 years, weighing 30 pounds (13.5 Kg), was admitted to the Nassau Hospital, Mineola, N. Y., on April 9, 1937, and was discharged on May 5. He had undergone myringotomy on both sides on March 17. After this he had an irregular fever together with a fairly profuse aural discharge on both sides. The temperature ranged from 102 to 103 F, with an occasional rise to 104 for several days prior to admission. At a consultation with Drs. L. A. Van Kleeck and William McKay on the afternoon of admission the findings were negative, except for mastoiditis on both sides. Roentgenographic examination at this time showed mastoiditis with beginning breaking down in the cellular structure of both mastoids.

On April 9 mastoidectomy was done on both sides. There was beginning breaking down of the mastoid cells, with free pus on both sides. There was no exposure of the sinus or the dura.

The child continued to have a septic temperature. He received a transfusion of 180 cc of blood on April 11. The temperature continued septic, with a rise to 105 F on April 17. On April 19 his general well-being, with his septic temperature, made us think that we were dealing with thrombosis of a lateral sinus. Several blood cultures, prior to this, gave negative results, as did roentgenographic examination of his chest and nasal sinuses. He showed no symptoms of meningitis. A spinal puncture to determine the spinal fluid pressure on compression of the jugular vein was done. Much to our surprise, cloudy spinal fluid was obtained, with a count of 4,300 cells.

Immediate revision of both mastoidectomy incisions, with exposure of the dura of the anterior and middle fossae, was done. Search was made for sinuses leading to the petrous apex. The findings were negative on both sides.

<sup>2</sup> The name prontosil has been applied to several different preparations. The one that we used was the disodium salt of 4'-sulfamidophenyl-2-azo-7-acetylamino-1-hydroxynaphthalene-3,6-disulfonic acid.

On April 20 a second transfusion, of 200 cc of blood, was given

The patient received sulfanilamide, 15 grains (0.97 Gm) daily, from March 31 to April 5 and from the date of hospitalization, April 9, until April 19, when the daily dose was increased to 30 grains (1.94 Gm). On April 25 the dose was reduced to 20 grains (1.29 Gm) daily, and on May 2 to 15 grains (0.97 Gm) daily until his discharge on May 5.

The temperature was not over 100 F in the eight days prior to the patient's discharge. Both ear drums were healed, and the incisions were nearly healed when he was discharged.

TABLE 2—*Findings in the Spinal Fluid*

Date	Polymorphonuclears,		Culture
	Cells	Percentage	
4/19	4,300	92	Hemolytic streptococcus
4/21	1,300	83	Hemolytic streptococcus
4/23	730	86	Negative
4/25	240	65	Negative

#### COMMENT

One of the most interesting problems that this case presented was When did the meningitis develop? When we did a spinal puncture on April 19, general well-being, associated with a septic temperature and the absence of signs of meningitis, made us think that we were probably dealing with thrombosis of a lateral sinus. The spinal puncture was done to determine if by compression of the jugular veins any obstruction of one or the other of the lateral sinuses, as shown by the spinal fluid pressure, could be determined. The finding of cloudy spinal fluid, which culture later proved to contain a hemolytic streptococcus, was a surprise to us. This caused us to wonder if when sulfanilamide is given it may partially control meningitis, so that one must suspect the presence of the disease when there is a septic temperature, even in the absence of the symptoms—rigid neck, Kernig sign, partial coma, etc—which are commonly associated with this disease. Of course, it will take a long clinical experience with sulfanilamide to answer this.

#### SUMMARY

Two cases of meningitis of otic origin caused by a hemolytic streptococcus with recovery after the use of prontosil and sulfanilamide are reported.

We believe that in cases of this condition there should be as complete a surgical removal of the focus of infection as is possible.

We suggest the possibility that a moderate dose of sulfanilamide will partially control meningitis so that it will present a different clinical picture from the one with which physicians are familiar.

We were assisted in the treatment of these patients by advice from Dr. Perrin H. Long.

# ETIOLOGY. PROPHYLAXIS AND TREATMENT OF SURGICAL SEPTICEMIA

A DISCUSSION OF THE PRINCIPLES INVOLVED

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Normally, the blood has a remarkable capacity for rapidly clearing itself of micro-organisms. At least, this has been abundantly proved experimentally with the lower animals when large numbers have been introduced directly into the blood, and it doubtless holds true for human beings as well. Furthermore, organisms, particularly streptococci of low virulence, may be intermittently present in the blood, as detected by cultures, when there is no clinical evidence of infection and especially in persons with chronic foci of infection about the teeth and tonsils. This constitutes bacteremia and probably occurs more frequently than is ordinarily surmised. However, when the blood is invaded by organisms of high virulence and the clearing mechanism is inadequate or fails, with possibly some actual proliferation and the production of toxins, this tissue may be regarded as being infected, which constitutes septicemia.

The same may occur with organisms of low virulence in persons of lowered resistance, that is, in persons of reduced clearing capacity.

Since such factors are of fundamental importance in relation to the etiology of septicemia, they may be discussed with more detail, especially since any knowledge physicians possess of the cause of septicemia is necessarily of fundamental importance in relation to its prophylaxis and treatment.

In the first place, virulence refers not only to the capacity of organisms for producing toxins but likewise to their invasiveness or their capacity for spreading rapidly in the tissues. As a matter of fact, organisms like the bacilli of diphtheria, tetanus and gangrene, which owe their virulence almost entirely to the production of powerful toxins in localized foci of infection, rarely produce septicemia. The most dangerous ones are those like streptococci and staphylococci, which not only produce toxins but are highly invasive. Under these conditions

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it would appear that septicemia is in most cases a result of loss of equilibrium, in which a rapid overflow of organisms from extensive or numerous foci of infection cannot be effectively balanced by the mechanism which removes them or in which a less rapid overflow results in a similar accumulation because the clearing mechanism is in some way put out of action, presumably by the toxins.

It is readily understood, therefore, that septicemia involves not only the matter of virulence on the part of the organism but, even more importantly, the state of resistance on the part of the host, which includes the capacity for removing organisms from the blood and for neutralizing their toxins.

The clearing mechanism is largely dependent on phagocytosis by the sessile histiocytes in such reticulo-endothelial depots as the liver, spleen and lymphatic glands, the polymorphonuclear leukocytes and the macrophages in the lungs. But this important phagocytosis, on the other hand, is largely dependent on certain antibodies in the blood, particularly the opsonins, which render organisms susceptible to phagocytosis, and also the agglutinins, which flocculate organisms into aggregates which are filtered off in the pulmonary capillaries and undergo phagocytosis.

Furthermore, a direct bactericidal action of the plasma plays a part in the clearing mechanism, owing not only to the activity of bacteriolytins aided by agglutinins but likewise to such nonspecific bactericidal agents as the leukins from leukocytes and the plakins from platelets. In addition, the presence of natural antitoxins appears to play a rôle, in the sense that neutralization of toxins results in less crippling of cells concerned in phagocytosis, which is of such primary importance in the whole mechanism.

No wonder, therefore, that surgical and biologic therapy continue to be of fundamental importance in relation to prophylaxis and, with the aid of chemotherapy, in treatment.

By surgical therapy I refer to adequate surgical drainage not only of the primary focus of infection but of the secondary embolic and suppurative foci, which are so likely to develop in streptococcic or staphylococcic septicemia in persons who survive sufficiently long for their development.

In other words, septicemia is not due as much to multiplication of bacteria in the blood as to constant invasion by organisms proliferating in the primary and secondary foci of infection. Therefore, the first principle in treatment should be the establishment of the best possible drainage of these foci. I realize that this requires the best of surgical judgment, because too hasty or too extensive operative procedures may break down the important walling off of the areas of thrombophlebitis.

and lymphangitis of the local lesions as well as favor extension of infection into surrounding tissues. Nevertheless, prompt and adequate surgical drainage of the primary focus is of fundamental importance in both prophylaxis and treatment, along with eternal vigilance for the detection of secondary foci and their prompt drainage whenever possible, should septicemia develop.

By biologic therapy I refer to such measures as may be taken in aiding the clearing mechanism. As previously mentioned, this depends on phagocytosis aided by opsonins and agglutinins, bacteriolysis in which complement is required, antitoxins for the neutralization of soluble toxins and lastly such nonspecific agents as leukins and plakins, which possess some bactericidal activity.

For infections due to hemolytic streptococci of group A, which embrace those so likely to produce septicemia, I believe that the possible prophylactic administration of one or two intramuscular injections of from 10 to 20 cc of concentrated antistreptococcus serum has been overlooked and neglected. Of course no one wishes to administer such serum needlessly because of the danger of allergic sensitization, but without doubt all immune serums possess far more prophylactic than curative activity. In the case of concentrated polyvalent antistreptococcus serum one may hope that it possesses sufficient antitoxin to help in protecting the phagocytes from the crippling effects of toxins besides furnishing sufficient opsonin and agglutinin for aiding the clearing mechanism should organisms gain access to the blood. In other words, its main function is to protect unaffected tissues. Therefore, I think it is excellent practice always and as a routine to culture material from primary foci at the time of operation and if hemolytic streptococci are found in cases in which septicemia is to be feared to consider seriously prompt prophylactic administration of the serum.

In this connection, blood transfusion would also appear to be of prophylactic value in the way of furnishing the patient not only with additional healthy polymorphonuclear leukocytes and complement but with such natural antibodies as opsonin and agglutinin for aiding phagocytosis and possibly bactericidal antibody, including the nonspecific leukins and plakins. Therefore the prophylactic value of one or more blood transfusions before or after operation should always be seriously considered, especially in cases of extensive infection and those in which general resistance is regarded as low by reason of prolonged infection and anemia.

Whether or not sulfanilamide (para-aminobenzenesulfonamide base) in tablets by oral administration or a soluble salt known as *prontosil*<sup>1</sup> by

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<sup>1</sup> The term "*prontosil*" has been applied to several preparations. The one referred to here is the disodium salt of 4'-sulfamido-2-azo-7-acetylamino-1-hydroxynaphthalene-3, 6-disulfonic acid.



intramuscular injection possesses prophylactic value cannot be stated at the present time. But in hemolytic streptococcic infections the administration of these substances may be likewise considered, and it is my practice to give four intramuscular injections of prontosil in doses of 10 cc each at twelve hour intervals followed by from 4 to 6 tablets of sulfanilamide orally per day for a week along with intramuscular injections of concentrated antistreptococcus serum or blood transfusions for prophylactic purposes in selected cases.

For the treatment also of septicemia due to hemolytic streptococci, I am in favor of the early administration of polyvalent antistreptococcus serum in large doses by intravenous injection every eight to twelve hours for at least four to six doses. Whenever possible the laboratory should test several antistreptococcus serums for agglutinating titer for the streptococcus recovered from cultures of blood, preference should be given the serum of highest titer, for it is always likely to contain more opsonin and antitoxin as well. Of course, the necessary precautions against allergic shock must be taken, including its slow administration after dilution with two or three volumes of sterile saline solution. Unfortunately and altogether too frequently, its administration is delayed too long, and in advanced stages it is without benefit. As with all immune serums, including the antitoxins, the keynote of therapeutic efficacy is in early administration of large doses.

Unfortunately, there is no equally efficient serum for treatment of staphylococcic septicemia, but I am favorably impressed with the occasional therapeutic benefit attending the intravenous administration of bacteriophage, provided one is obtained which is found in the laboratory to be actively lytic for the staphylococcus recovered in cultures of blood. Indeed, I believe that its administration should always be included in the treatment of this highly mortal type of septicemia, as part of the therapeutic program.

However, whether or not the serum or bacteriophage is administered, transfusion of from 200 to 300 cc of blood every three days should be given as a routine and as early as possible, not so much for supplying erythrocytes and hemoglobin as for furnishing healthy leukocytes as well as complement, opsonin, agglutinin, leukins and plakins. In securing blood for patients with streptococcic septicemia preference should be given to such compatible donors as have had surgical streptococcic infections or scarlet fever, because of the increased chances of furnishing the hard-pressed patient with specific antibody. In this connection, I may state that I am much in favor of the practice of Baun of selecting from the available donors the one whose blood serum shows the largest content of agglutinin for the streptococcus recovered from the cultures of blood, because, as previously stated, agglutinin favors the clearing mechanism in the way of promoting phagocytosis and bacteriolysis.

and its presence also indicates the possible presence of opsonin and other antibacterial antibodies. Furthermore, it would appear that non-specific immunotransfusions may be of more value than ordinary transfusions, at least from the theoretical standpoint. These consist in giving the donor intravenous injections of typhoid vaccine containing from 50,000,000 to 100,000,000 killed organisms and using the blood several hours later, after subsidence of the reaction of fever and chills. Under these conditions, the blood of the donor carries more leukocytes of probable value to the patient as well as possibly more leukins, plakins, opsonins and other antibacterial factors. Unfortunately, in a case of acute septicemia there is not sufficient time for the immunization of donors with repeated subcutaneous injections of a vaccine of the organism infecting the patient, but this is always advisable in a case of staphylococcic septicemia, since the patient is likely to require transfusions over a considerable period.

Unfortunately, none of these measures except surgical drainage is at all likely to reduce materially the degree of infection in the primary or secondary foci of infection in the fixed tissues. Biologic therapy only aids the clearing mechanism, and the treatment of septicemia will never be satisfactorily solved until chemotherapeutic research reveals a compound capable of disinfecting the fixed tissues with all the efficiency of the arsphenamines in the destruction of *Spirochaeta pallida*. No wonder, therefore, that the chemotherapy of septicemia has largely been a disappointment despite isolated case reports alleging or intimating that recovery was due to the administration of this or that chemical agent. Luckily, however, it would appear that in sulfanilamide a chemical agent of real value has been evolved for the treatment of infections due to the beta hemolytic streptococcus, as the compound has proved clinically of encouraging value, probably by reason of promoting phagocytosis. It is of low toxicity and is usually well borne. The soluble prontosil<sup>1</sup> is dispensed as a 2.5 per cent solution for intramuscular (preferred) or intravenous injection, prontosil tablets<sup>2</sup> are but feebly soluble and are dispensed orally in doses of 5 grains (0.32 Gm.) each. My present practice is to administer these compounds every six hours as follows until the blood cultures are sterile:

1 to 5 years	2 cc intramuscularly, ½ tablet orally
6 to 15 years	5 cc intramuscularly, 1 tablet orally
Adults	10 cc intramuscularly, 2 tablets orally
or	20 cc intramuscularly, 1 tablet orally

As soon as sterile blood cultures are observed, along with clinical improvement, I stop the intramuscular injections, but I continue to give the tablets for from one to two weeks.

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<sup>2</sup> Prontosil tablets are the hydrochloride of 4'-sulfamido-2,4-diamino-azo-benzene.

For staphylococcic septicemia, however, there is not yet available a chemical agent of equal value, although it is my custom to give from 10 to 20 cc of Pregl's solution of iodine or similar doses of a 1,000 solution of metaphen every twelve hours for at least four to six doses because of individual cases in which I had reason to suspect that these compounds were at least helpful.

It is readily understood, therefore, that there is not yet a royal road to the treatment of surgical septicemia, involving as it does, a judicious combination of surgical intervention, biologic therapy and chemotherapy. Furthermore, certain general measures always require careful consideration, among these may be mentioned the advisability of keeping the tongue moist by sufficient intake of fluids (about 3,000 cc per day for the adult), including the administration of dextrose (preferably a 5 per cent solution by bowel in order to spare the veins), the relief of distention by turpentine stupes or solution of posterior pituitary, the administration of whisky or brandy, preferably in egg-nogs, and the administration of digitalis, strychnine or other cardiac stimulants, as well as the important matter of insuring adequate rest for the patient. To this end the therapeutic program should be carefully outlined each day and morphine should be given subcutaneously as required, since this is far better practice than to allow a restless patient in pain or distress to reach a stage of exhaustion.

#### SUMMARY

1 Normally the lower animals and human beings are protected against bacteremia and septicemia by a remarkable mechanism for clearing the blood of invading organisms through phagocytosis on the part of leukocytes, the histiocytes of the reticulo-endothelium and the macrophages of the lungs, aided by opsonins and agglutinins.

2 Additional factors in this antibacterial immunity are the natural antitoxins, bacteriolysins and such nonspecific agents as the leukins and plakins.

3 Septicemia is the result of virulence of the infecting organism, a deficiency on the part of the clearing mechanism or a combination of the two.

4 Virulence refers not only to the production of toxins but to the capacity of the organism for invading the fixed tissues and the blood.

5 In both the prophylaxis and the treatment of surgical septicemia adequate but skilful and judicious surgical drainage of the primary and secondary foci of infection is of paramount importance.

6 Prophylaxis may be aided by the intramuscular injection of anti-streptococcus serum and particularly by blood transfusions before or after surgical operation, as well as, possibly, by the administration of sulfanilamide or one of its derivatives.

7 Biologic therapy plays an important part in the treatment of surgical septicemia and includes the early administration of large amounts of antistreptococcus serum or staphylococcus bacteriophage by intravenous injection as well as by transfusions of normal or immune blood every three days

8 Sulfanilamide (para-aminobenzenesulfonamide base) by oral administration and a derivative, prontosil, by intravenous or intramuscular injection are recommended for the chemotherapy of septicemia due to the beta hemolytic streptococcus, and Pregl's solution of iodine and metaphen by intravenous injection, for staphylococcic septicemia

9 Important adjuvant measures embrace adequate intake of fluids, administration of dextrose, relief of distention, and sedation with morphine

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# SMALL DOSES OF INSULIN IN OTOLARYNGOLOGIC PRACTICE

CLINICAL EXPERIENCE OF A CORRESPONDENCE STUDY GROUP

D C JARVIS, M D

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## INTRODUCTION

The natural sequence of events following the introduction of any new therapeutic agent or method has plotted a similar course throughout the history of medicine. Characteristic of medicine today is its insistence on rationalization, but equally important for advancement is the empirical trial of drugs and methods in conditions other than the ones for which they were originally intended. The widespread use of fever therapy, the treatment of lobar pneumonia with pneumothorax and the administration of the arsenical preparations in conditions other than syphilis are but a few examples of this tendency.

It is therefore not surprising that the introduction of a drug so spectacular in its specific effect as is insulin should occasion its trial in many conditions other than diabetes mellitus, for which it had been sought for years.

The present knowledge regarding its physiologic activity has been derived largely from two main sources. These two sources are observations of its effect on diabetic persons and experiments on animals. Experience with small doses of insulin is showing that deductions from one or both of these sources of information cannot always be applied to the normal nondiabetic patient and that the sum of knowledge is not yet sufficient for interpretation of all observations.

## SIZE OF DOSE

The dose of insulin must be small, so that no epinephrine will be discharged from the adrenal glands. The interval between doses must be of such length that clinical progress is maintained. Large doses of insulin produce edema, while small doses cure it. When small doses of insulin are given over a period of months, if slight edema of the tissues appears it is an indication either to lengthen the interval between doses or to reduce the size of the dose.

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Read at the Forty-Third Annual Meeting of the American Laryngological, Rhinological and Otological Society, Inc., Atlantic City, N J, June 5, 1937

As to the size of the dose in this new found use of insulin, 5 units constitutes a maximum dose, 1 unit a minimum dose and 3 units the average dose. Five unit doses are rarely used. Three units is the usual dose. It is given subcutaneously each day if the clinical need is great. As clinical improvement takes place, the interval between doses is lengthened to every other day and later to Tuesdays and Fridays or a similar interval. When insulin is given over a period of months, the 3 unit dose is eventually given once a week.

#### GENERAL CLINICAL CONDITIONS IN WHICH SMALL DOSES OF INSULIN HAVE BEEN FOUND TO BE OF VALUE

The list of conditions in which members of the group have found that the use of insulin brings clinical results is a long one. These are

- 1 Any break in surface tissue, either skin or mucous membrane, such as ulcer of the cornea, syphilitic ulceration of the throat, bed sores in the aged, ulcer on the leg or wounds for which rapid healing is desirable.
- 2 Disturbance of the water balance of the body, as indicated by a watery discharge from the nose, edema of the pharyngeal or laryngeal region, edema of the ankles, puffiness of the eyelids or angioneurotic edema.
- 3 Mucopurulent or purulent discharge from the ears or the paranasal sinuses, postnasal dripping, pulmonary abscess or infected wounds.
- 4 Blood clots, such as those caused by cerebral hemorrhage, retinal hemorrhage, hemorrhage of the bulbar conjunctiva or hemorrhage into the anterior chamber of the eye, insulin hastening absorption.
- 5 Disturbance of circulation, such as that in Raynaud's disease.

This list of clinical conditions is long and broad in its scope and brings to mind the question as to what underlying clinical fundamentals one is observing when one secures clinical results in so many types of clinical condition from the use of small doses of insulin given subcutaneously. The answering of this question brings one to a consideration of the theory of oxygen metabolism.

#### THE THEORY OF OXYGEN METABOLISM

- 1 The theory of oxygen metabolism is based on the assumption that the central problem in medicine is not one of infection but one of oxygen metabolism.

- 2 Sixty-five per cent of the elementary composition of the human body is represented by oxygen, which indicates its importance. The remainder of the elementary composition of the human body is represented by minerals.

- 3 Oxidizing catalysts required by the body are taken in as minerals, found chiefly in fruits, nuts and vegetables.

4 A lack or insufficient intake of oxidizing catalysts results in a block in the carbohydrate oxidizing chain

5 The body in order to overcome this block in oxygen metabolism breaks down tissues to obtain the desired minerals which are normally present in its composition

6 This breaking down of body tissues to secure the necessary minerals with which to carry on oxygen metabolism is made known clinically by the appearance of albumin, sugar, pus or all three in the urine, a change in the normal secretion from the mucous membrane, the appearance of a purulent discharge in various parts of the body and loss in continuity of tissue, as seen in ulceration

7 The presentation of oxidizing catalysts to the body in the form of small doses of insulin, thyroid, dilute hydrochloric acid, iodine, and fruit and vegetable juices for their mineral content generally results in disappearance of albumin and sugar from the urine return to normal of the secretion from the mucous membrane, disappearance of a purulent discharge when it is present in various parts of the body and healing of a break in the continuity of tissue

#### CLINICAL APPLICATION OF THE THEORY OF OXYGEN METABOLISM BY MEANS OF SMALL DOSES OF INSULIN GIVEN SUBCUTANEOUSLY

*The Common Cold* —*Prevention* In dealing with the common cold one needs to appreciate the fact that there are ten different varieties and that some of these ten are due to environmental conditions directly controllable by the patient. Other than these, the common cold may be prevented by giving 3 units of insulin subcutaneously every ten to fifteen days, depending on how susceptible the person is to colds, and including in the diet foods representing a good source of iodine, iron, copper and manganese, the four best oxidizing minerals. Because they require oxidation in the body, the intake of carbohydrate foods is kept low in order to lessen the load of oxidation.

*Relief of Symptoms* When a patient has a common cold, he comes to the office once a day for three days. Each day he is given 3 units of insulin subcutaneously. As beef and pork insulin are both on the market, he is asked if he is sensitive to either beef or pork. If sensitive to one, he is given insulin prepared from the other.

As a rule, the first treatment will bring about 50 per cent improvement. The second treatment will generally complete the relief from symptoms, but a third treatment is given to make sure of the results desired. By the use of oxidizing catalysts, such as small doses of insulin and a low intake of carbohydrate food to be oxidized, the common cold in the majority of cases may be limited to twenty-four or forty-eight hours' duration.

*Secretion Within the Nose*—Dried secretion within the nose and mucopurulent threadlike bridges extending from the nasal septum to the outer wall of the nose are present when the carbohydrate intake is greater than the patient can oxidize into heat, energy, water and carbon dioxide

If the patient is annoyed by the presence of dried secretion within the nose and the necessity of always carrying a handkerchief for the blowing of the nose that is required from time to time, 3 units of insulin given subcutaneously each day will clear up the abnormal secretion within the nose in from one to three days. Reduction in the intake of food requiring oxidation will maintain the improvement within the nose and allow the use of insulin to be discontinued

*Nasal Polypi*—Three units of insulin given at intervals such as Tuesdays and Fridays represent will dehydrate nasal polypi. So far as dehydration will result in improvement, improvement will come. Recently developed polypi will disappear from the nose, but if a polypus is well organized, insulin will not reduce its size, an operation being necessary for its removal

*Acute Otitis Media*—My own interest in the relation of small doses of insulin to acute otitis media was aroused when Dr. Nan L. Gilkerson, of Amarillo, Texas, sent me a letter for the group in which she wrote in part, as follows: "My use of 3 unit doses of insulin in the treatment of infections of the middle ear during the swimming season has been successful." This letter brought with it a desire to try out 3 unit doses of insulin in acute otitis media

On Sept. 19, 1935, a farmer about 30 years of age came to the office early in the day, stating that he had been having a head cold for the past few days and that earache in the right ear had developed during the previous evening. This pain became so severe that during the night he required an injection of morphine to secure enough relief from the pain to enable him to pass the night. He stated that the night was passed without sleep. At the time of his visit to the office, the pain in the ear was still severe. Examination showed a bulging and reddened ear drum. All the classic indications for paracentesis were present: extreme pain, extreme bulging and extreme redness. It occurred to me that a better case could never be had to test whether insulin in small doses is of value in acute otitis media. Nothing was done to the ear except to instil a thin nasal spray oil as a placebo. He was given 3 units of insulin subcutaneously in the arm. For home use, he was given the same oil to be instilled in the ear every two or three hours and "pain pills" each containing  $3\frac{1}{2}$  grains (0.22 Gm.) of acetylsalicylic acid, 1 to be taken every three hours.

The following morning he returned to the office and reported that with the help of the pills he had been fairly comfortable since his first visit to the office. Examination of the ear, much to my surprise, showed that the bulging was all gone and about 50 per cent of the redness of the ear drum had disappeared. Three units of insulin was again given subcutaneously. I told him to see me the following day, September 21, if his pain returned and was severe.



but to be sure to return to the office on September 23 for a check-up of his ear I did not see him until September 23, at which time he stated that his ear had been comfortable Examination showed a normal ear drum, with the exception of a slight redness of Shrapnell's membrane I tested the hearing in this ear and found that he could hear a whisper at 20 feet (6 meters) the same as he could with the other ear

I concluded that this result had just happened and could never be repeated, but on Sept 20, 1935, a young married woman came to the office with the same clinical symptoms A head cold was followed by severe pain in the ear, with bulging and redness of the drum head Again, 3 units of insulin was given subcutaneously in the arm together with a thin oil to use in the ear as a placebo and the aforementioned "pain pills"

The following day, September 21, she reported at the office stating that while the pain had not wholly disappeared, it was bearable with the aid of the "pain pills" Again bulging of the drum head had disappeared and the redness had diminished She was given 3 units of insulin subcutaneously and did not return to the office until September 24 At this visit she stated she had been free from pain since the visit on September 21, but that the ear felt uncomfortable and she feared lest pain might return and therefore she came to the office The drum head showed a slight amount of redness in the posterior inferior quadrant, but the cone of light was present With this ear she could hear a whisper at 15 feet (4.5 meters) She was given 3 units of insulin subcutaneously and was requested to return to the office if her ear continued to trouble her She did not return

*Chronic Suppurative Otitis Media*—Dr Henry Goodyear, of Cincinnati, wrote me as follows

I have found small doses of insulin helpful in stimulating recovery in chronic infections Recently, I had a patient aged 49 with a central perforation of the ear drum and constant mucopurulent discharge from the ear for two years She had been treated without relief I tried treating her for eight weeks without any improvement resulting Finally, I gave her 5 units of insulin She returned to the office five days later, stating that the ear was dry for the first time in two years This happened six weeks ago, and the ear had remained dry This may have been only a coincidence I can scarcely see how one injection could turn the tide

This observation of Dr Goodyear's is similar to those I have made in my own practice

The first case in which this happened was that of a high school student who came to the office with a discharge from both ears, which developed during an attack of influenza A reduction in the intake of carbohydrates plus dry treatment with wicks in the auditory canal and iodine by mouth each day dried up the discharge from the right ear and diminished the amount in the left ear In addition, Sulzberger's powder (boric acid and iodine) was used in the left ear Finally, when failure to bring about disappearance of the discharge by local treatment seemed evident, I decided to try 3 units of insulin given subcutaneously in the arm Three days later, the ear was found to be nearly dry Three units of insulin was given on Oct 11, 14, 17, 22, 25 and 28, 1935 On October 28 both ears were dry, with hearing for a whisper at 20 feet (6 meters) in both ears I checked up

the condition of this patient at the opening of school in 1936 Both ears have remained dry since October 1935 A whisper at twenty feet (6 meters) can still be heard in both ears

Dr Frank M Adams, of Providence, R I, wrote

Commenting on the group letter, page 1192-1193, relative to acute rhino-otologic infectious processes, let me tell you about my experience with insulin in my own family, in which we have three diabetic children

In the presence of acute infection of the throat, nose and ears, an increased dose of insulin has been responsible for a practical abortion of all symptoms in twenty-four hours This observation covers about eight years for the three patients They have not been away from school or college one single day in that time and have faced several severe endemic and epidemic visitations in these eight years Insulin definitely has the power of increasing resistance to infection

*Furuncle of External Auditory Canal*—Small doses of insulin subcutaneously in the arm are of real value in furuncle of the external auditory canal Their use shortens the duration of this clinical condition and aids in preventing the appearance of additional furuncles The insulin is given at first every day until the furuncle is under control, then every other day as long as is necessary

*Dizziness*—In patients complaining of progressive loss of hearing with dizziness, 3 unit doses of insulin, subcutaneously, every four days will generally relieve the dizziness in from two to four weeks

*Edema*—I shall turn my attention briefly to the influence of small doses of insulin on edema of the pharyngeal and laryngeal region

The following case report was sent me by Dr Fred Hill, of Waterville, Maine

Since returning from the meeting in Charleston, S C, I have been looking for an opportunity of using insulin in the treatment of laryngeal edema Recently, I have had this privilege I was called in consultation to see a patient in another hospital because of edema of the throat and larynx following streptococcic infection He showed marked edema of the uvula extending up in the soft palate and the lateral pharyngeal walls There was less edema of the epiglottis and the aryteno-epiglottidean folds When I saw him, the glottis itself was fairly free I suggested the use of insulin as well as scarification of the uvula Several hours later, I was called again, and on examining the uvula found evidence of just two slight incisions on the right side I advised further scarification As the patient objected, I did not insist, thinking that I would see what the insulin alone would do The next day, I received the report that the edema had markedly subsided and the patient was comfortable This was after two doses of 5 units of insulin

Dr John Pratt, of Minneapolis, Minn, sent me the following case report

Mr D T, aged 27, had recently had acute edema The nose and the nasopharynx were entirely closed, and the eyelids, upper lip and cheeks were greatly swollen The uvula was about the size of a thumb Sodium bicarbonate and iodine

and 4 units of insulin were given when he came in the morning, and he went to work in the afternoon. The next morning when another 4 units of insulin was given, the swelling of the face had practically gone and he could breathe a little through his nose. He was told not to return for three days if he continued to improve. When he returned, he was entirely normal.

Dr. John G. McLaurin, of Dallas, Texas, sent me the following statement:

Miss M. W., aged 20, was examined first on May 4, 1936. The history stated that she had been suffering from influenza for the past three weeks, but for three days her throat had been gradually swelling to the extent that it was almost impossible for her to breathe and she had been unable to swallow food for twenty-four hours prior to the time she saw me. She had had a rather high temperature for the past three days, though it was only 101 F at the time she came to my office. The respiratory rate was about 36, and each inspiration was short and difficult. Her throat showed slight edema of the glottis and the tonsil pillars. The tonsils had been removed cleanly. The glotto-epiglottidean sulcus was obliterated by swelling, and the free border of the epiglottis could be seen as a sunken line of attachment of the membrane, which was swollen on both the anterior and the posterior surface so markedly that it extended above the free border. The right aryepiglottidean fold was so swollen that it was impossible for me to see the small chink through which she was breathing. There was no ulceration in the larynx or in any part of the throat. Her nose showed a general redness of the membrane, with some mucopurulent secretion postnasally. Cultures were taken on brain broth and blood agar, and a growth of chain streptococci was noted in the brain broth.

The patient was sent to the hospital from my office, and 5 units of insulin was given every twelve hours. She was given chipped ice by mouth, and an ice bag was placed on her throat. I would have been perfectly justified in doing a tracheotomy when I first saw her. The color was good, and I decided that I would see what could be done by the use of insulin. No dextrose was given to her intravenously. Within twelve hours from the time the first dose of insulin was given, she was better, and within twenty-four hours she was apparently on safe ground, though there was some edema, which gradually subsided over four days. By following this plan of therapy, I got an excellent result and a quick response in controlling the edema. This was an interesting case for me, and I feel that insulin unquestionably cured this patient.

*Ulceration of Throat*—Dr. Francis B. Blackman, of Columbus, Ga., sent me the following report:

Since my return from the meeting of the American Laryngological, Rhinological and Otological Society, in Charleston, S. C., I have been fortunate enough to be allowed to treat a most interesting patient. This patient had a 4 plus Wassermann reaction, tremendously enlarged cervical glands and a hole sloughed out in the region of the tonsil dangerously near the greater vessels of the neck. Anti-syphilitic treatment apparently had no effect. He had recently had a severe hemorrhage from his throat, and from what I learned from his family physician, he had come very near bleeding to death. I have seen him for about a week at the time of writing, and in this time, with the addition of 3 units of insulin to the treatment, the foul ulcer has cleansed itself, leaving a red surface. At the last visit, the ulcer was healing rapidly.

Insulin in 3 small doses is of value in treating ulceration in other parts of the body such as corneal ulcer, ulcers of the leg and bed sores

#### SUMMARY

1 Insulin in small doses averaging 3 units acts as an oxidizing catalyst. Oxygen metabolism influences the behavior of the autonomic nervous system. An effect on the parasympathetic nervous system is secured, the insulin apparently blocking off the sympathetic division.

2 Insulin in small doses generally limits the duration of a common cold to twenty-four or forty-eight hours.

3 Insulin in small doses is of value in influencing secretion from the mucous membrane in dehydrating nasal polypi and in relieving acute otitis media and chronic suppurative otitis media.

4 Insulin in small doses is of value in treating ulceration of the tissue.

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# DYSPHEMIA AND DYSPHONIA

## CARDINAL FEATURES OF THREE TYPES OF FUNCTIONAL SYNDROME STUTTERING, APHONIA AND FALSETTO (MALE)

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The conditions of dysphemia and dysphonia which I am about to discuss, although definitely dissimilar in their clinical aspects, are similar in other aspects. For example, all these conditions—stuttering, hysterical aphonia and paraphonia (falsetto voice)—indicate individual biologic inadequacies, that is, basic constitutional or organic inferiorities. Furthermore, the etiology, or the more immediate origin of the symptomatology, is psychologic, while the expression is physiologic.

The conduct, affects, attitudes and productions of these patients lead one to conclude that their psychologic functioning is unique in many important respects. Their subjective sense of values differs from that of the average person. Hence, their reactions are both qualitatively and quantitatively different.

These differences strike one frequently as differences in emotional threshold, special psychosomatic dispositions serving as the foundation for deviations in emotional attitudes in later years.

As far as physique is concerned, there is no difference between a person suffering from stuttering and one suffering from aphonia. However, on the basis of my experience, in the case of the falsetto voice there is a distinct variation as to type. According to Kretschmer,<sup>1</sup> there are three major physical types: asthenic, athletic and pyknic. In addition to these three principal types, there is also a fourth, the dysplastic, which includes many digressions from the average, based chiefly on endocrine changes and resulting in disproportions. A recent study of

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<sup>1</sup> Kretschmer, E. *Physique and Character*, translated by A. Sprott, London, Kegan Paul, Trench, Trubner & Co., 1925.

12 of my cases of falsetto voice showed the following distribution of body types

Asthenic	3
Athletic	.0
Pyknic	2
Dysplastic	7
Asthenico-Pyknic	
Asthenico-Eunuchoid	
Pyknic mixture	
Eunuchoid	

Thus, the predominant type is dysplastic, that is, a composite of the asthenic, pyknic and eunuchoid

However, regardless of type, and although the adult male with a falsetto voice may show a tendency toward femininity, there are no anomalies of the genitalia, either anatomic or physiologic

In regard to the etiology of stuttering, aphonia and falsetto voice, an anxiety state is an essential etiologic factor, particularly in the first two conditions, and psychologic investigation and treatment are clearly indicated. All three conditions are precipitated by special happenings during development or later in life. The responsiveness of the motor act varies with the degree of emotional balance present and offers objective evidence of the functional activities experienced by the person. States of increased emotional tension—emotional imbalance—are always associated with increased functional activity. Mind expresses itself in muscular and nervous responses. There is evidence that the mechanics of emotional balance are largely contingent on the balanced opposition of the parasympathetic and sympathetic divisions of the autonomic, or vegetative, nervous system. Because of the multiplicity of the functions of the autonomic system, an imbalance in this delicately adjusted apparatus may destroy the physiologic equilibrium between the two divisions and may produce a great variety of symptoms.

I shall first consider stuttering. At present, among the different workers in the field, there is increasing unanimity that the one outstanding somatic finding is marked instability in the functioning of the vegetative nervous system, with special dysfunction of the vasomotor apparatus. Professor Seemann,<sup>2</sup> reporting a study of 260 stutterers, stated that he found an imbalance of the vegetative nervous system in 88 per cent of the subjects. Thirty-six per cent demonstrated sympathetic dominance, 18 per cent showed parasympathetic dominance, and 34 per cent showed evidences of increased tonus in segments of both branches of the vegetative nervous system, or amphotonia.

<sup>2</sup> Seemann, M. Somatic Findings in Stutterers, *Monatschr f Ohrenh* 68 895 (Aug) 1934

These deviations in the neurologic functioning of the stutter type person are manifest in his disorganized muscular coordinations. These incoordinations may appear in any neuromuscular activity and in many psychomotor patterns, but the fundamental characteristic is a lack of rhythm in performance. In other words, the stutter type person lacks harmony, he is out of tune, both neurologically and emotionally, and unequal to the strenuous tempo of life.

The respiratory tract is dominated by the parasympathetic division of the vegetative nervous system, and in the condition under consideration there is a continual conflict as to dominance, a mutual antagonism, going on between the parasympathetic and the sympathetic characteristics which the person possesses. For instance, under stress the stutterer, although a parasympathetic type, is rocketed to hypersympathetic dominance. He loses the proper balance in maintaining the physiologic functions of the vegetative nervous system, so that the excitation—the emotional state—engendered, for example, by a special examination of the nose and throat, will readily change his usually pale mucous membrane to pink or red. This is a physiologic alteration in the tonus of the peripheral vessels, a state of congestion, with no other local findings, and it can be observed for long periods.

The stutterer, or the stutter type person, as I designate him, thus falls into a special category. He suffers from a type of neurosis which one may term a "social neurosis." His abnormal response to environmental impacts is pronounced. He demonstrates strong excitation and a tendency to quick interruption or inhibition, accompanied by a high emotional tone, in social situations. On account of his special constitutional makeup, he is predisposed to acquire specific neurotic traits, provided a neurotic environment is present to stimulate the creation of the neurosis with its myriad symptomatology.

The stutter type person is a chronic hesitator and may demonstrate his hesitating performance not only in speech but in many other forms of psychomotor activity. However, since the neuromuscular coordinations involved in speaking are of a highly complex and delicately balanced nature and because speech is so necessary for normal social adjustment, the involvement of the speech faculty in this stutter type syndrome is a far more serious problem than stuttering or chronic hesitation in other muscular activities.

Because of the high emotional tone of the stutter type person, stuttering speech, with its usual history of humiliation, failures and frustrations, eventually leads to the development of an anxiety state regarding speech and maladjustment of the entire personality.

Not only does the stutterer demonstrate anticipatory anxiety and lack of emotional control in given situations, but almost always he is unable to throw off the effects of these situations after they have been

experienced. He becomes self-centered and oversensitive. His self-esteem is easily hurt, and his life is dominated by introversion and evasion, frequently accompanied with an assumption of superintellectuality, with which he consciously or unconsciously cloaks his feeling of inadequacy.

Since I view stuttering primarily as a physical manifestation of psychic conflict, with the high emotional energy of the stutterer turned in the direction of a fear which warps his entire personality, I have arranged a composite therapy of a medical, social, psychiatric and psychologic nature. This composite therapy is directed toward the integration of the stutterer's vital personality drives with a view to placing them in their proper relationship. As the stutterer's difficulty is one of social adjustment, these personality problems are worked out in a group medium, which I term open door psychiatry.

While the symptom stuttering is merely of secondary importance, I find a certain amount of speech reeducational work helpful. Technical faults respond to reeducational procedures, not to theoretical discourse alone. However, and this is of the utmost importance, throughout the treatment interest must be focused on the total personality of the patient.

The same general type of physical dysfunction due to psychic influence is seen in the person suffering from hysterical aphonia. It is not merely a question of treating the local involvement but a question of treating the *whole* personality in order to counteract the physiologizing of the emotions, with its resultant aphonia.

The following excerpt from a letter written by a woman of 28 gives an excellent example of the physical and emotional manifestations of hysterical aphonia.

I was wondering if you have ever come across anyone with the same peculiarity that I have. I am able to speak, but only in a whisper, and have been like this for the past four or five years. At the present time I am unable to talk at all and I have to resort to a pencil and paper as a means of communication. My voice comes back at intervals for a week or a month, but then goes for a year or so.

I was a stenographer, but have been out of work for several years. My parents have done everything suggested by our doctor and my throat specialist. I have had lamp treatments, have had several x-rays taken, have had my tonsils removed, and have had a complete rest. I seem better for a while, then my voice goes for another year or so. The specialist says my throat is normal, and he can see no reason why I cannot speak, but the fact remains that I cannot.

Lately I am beginning to find it very hard if I attend large gatherings where there are many people or much noise, trying to make myself understood seems to tire me very much and tends to make me sick all over.

My friends and acquaintances have no difficulty in understanding me, but other people do. It is a handicap when I am in an office, because I cannot answer the telephone. Persons hearing me for the first time as a rule comment on my very bad cold.



This letter, besides giving an excellent description of the objective and subjective symptoms, also mentions the typical list of physical therapeutic measures usually instituted, in many instances without avail. The reason for their futility is that the inhibition of the voice originates in the psyche and is not a local physical expression of a pathologic nature. Incidentally, since the mechanism of the disorder is unknown to the patient, it is difficult for her to realize her true status, hence she views her condition as a purely physical one and seeks physical aid.

Therapy to be effective must be directed to the elimination of the etiologic factor. The fear that inhibits the voice may be very difficult to ferret out, and it generally has a long chain of painful associations. It may be the result of long-suppressed hostility, feelings which have grown in magnitude and which overwhelm the sufferer and inhibit expression. Again, feelings of guilt and ideas of punishment, shame and embarrassment, inadequacy and inferiority may lead to the suppression of the voice. The *modus operandi* that produces the final result, as pointed out, is the involvement of the vegetative nervous system.

The third symptom complex is paraphoma, or falsetto voice. Perhaps the best way to introduce this subject is by means of another letter which gives a lucid description of the condition.

For over twenty-five years I have suffered the torments of the damned because of my voice. I am now over 40, married and the father of three grown children. My voice is high pitched, thin and piping like a woman's. I try to talk in my throat to disguise it as much as possible, until I have a superinferiority complex. Afraid to meet people, I shun all meetings and social activities. I have become disheartened and discouraged. I feel miserable every minute in the day and am looking forward to a ray of hope from you.

I am very sensitive about my voice, and a "man of few words" when I am in contact with people. All through high school I lived in a nightmare. I stammered in addition to having the high voice, and you can imagine my feelings.

Is there any hope of readjusting my speaking voice so I can assume my place in society? I realize the voice is the mouthpiece of personality, and I have been kept confined like a hermit when I want to do things and realize my ambition of leading a real, normal life. I know I could face the world and achieve my ambition if I only had a deep, normal male voice.

This letter, like the other, gives an excellent description of the objective and subjective symptoms. It refutes the popular fallacy of doubtful sexuality, since the patient has three children. This general erroneous point of view is decidedly humiliating and psychologically detrimental to the person and arises from the fact that a falsetto voice is characteristic of the eunuch or the eunuchoid.

Eunuchoids are persons who without being castrated entirely simulate in clinical manifestations the true eunuch type. This condition is due to a developmental disturbance beginning primarily in the sexual glands. One of the symptoms is a change in the pitch of the voice,

which becomes high. On account of this similarity, the term eunuchoid voice has been used synonymously with falsetto voice. Therefore, the use of this term has given rise to much misunderstanding, which is unfortunate for the patient having a falsetto voice. A falsetto voice of an adult male who is not a eunuch or a eunuchoid does not depend on imperfect genital development but in practically all cases is the result of a faulty habit contracted by the subject at the time of the change of voice and retained in after life.

Physicians are all familiar with the common physiologic changes that take place in children during puberty. Concomitant with the general systemic changes, there also occur mutations in the larynx and the voice. The larynx, through the change in the shape of the thyroid plates, grows forward so that there is greater prominence of the part which is commonly designated as the Adam's apple, this change being less marked and more gradual in the female. Measurements of the neck indicate that the position of the larynx is a little higher in females than in males. The vocal cords in males during this development become more elongated than those in females, this, plus the change in conformation, explains why the male voice is of a lower pitch and usually stronger. The pitch of the voice depends on the number of vibrations the vocal cords make during a second, and the number of vibrations depends on the length and width of the aperture through which the air passes, plus the degree of tension of the cords. The longer the cord, the less tension; the wider the glottis, the lower the voice.

The period of mutation of the voice is irregular in both boys and girls. Girls' voices break less often than boys' and gradually become fuller and more resonant. Boys' voices, after frequently breaking for a considerable period, finally become lowered about an octave. The mutation is sometimes gradual, sometimes rapid. A child may be slightly hoarse for a few days or weeks, and then the voice becomes standardized, or it may take a number of years before a permanent change takes place.

During mutation the successive changes in the form and size of the larynx take place so rapidly that proper realization of the changing conditions of tension is lost, and many bad vocal and speech habits may be contracted. The voice may become coarse or throaty, nasal, aspirate, guttural or growling, or it may continue in a childish treble. Articulation often suffers, and pronunciation is slovenly. Objectively, the larynx, irrespective of the vocal cords, sometimes shows slight hyperemia, which in itself is sufficient cause for the raucity of the voice. Often there is a disproportion in growth of the vocal cords and cartilages to which the cords are attached, resulting in unsteady tension of the cords, which is instrumental in producing a voice that occasionally breaks

to a childish treble. At this period also a misdirection of afferent impulses may result in the abuse and nonuse of certain sets of muscles, antagonistic in action, that come into play during voice production. This causes partial vibration of the vocal cords, impairment of resonance and misplacement of the larynx, so that it is seen in an abnormally high position. The voice emanating from such a larynx is high pitched, thin and piping—a falsetto voice.

A falsetto voice is often reckoned to the head register, its volume and area being almost as large as those of the chest register. It is of a thin, shrill quality, sounding forced or unnatural, and, as its name implies, is a false voice. In brief, it is a child's voice produced by an adult, originating at that period of life when physically the boy or girl is a man or woman in everything but voice. This voice suggests a lack of muscular control besides a disturbed balance in the respiratory act.

Of the various reasons given for the occurrence of this faulty voice condition, a disproportionate action of the laryngeal muscles, which is the end-result of a long chain of etiologic factors, usually accounts for the trouble. The larynx is poised in the correct position for speaking or singing through an equalized tug that goes on between the levator and the depressor muscles. If for some reason the pull on the depressor muscles is stronger and the larynx is lowered from its normal position, the voice assumes a heavy and unnatural low pitch. On the contrary, if the pull of the levator muscles is stronger and the larynx is raised high in the throat, the voice assumes a thin, high pitch. With this there is an abnormal action of the intrinsic muscles of the larynx, the tension between the cricothyroid and the thyro-arytenoid (vocalis) muscles is irregular, so that interference with the complete vibrations of the vocal cords takes place, the cords only partially vibrating. These changes necessarily produce a disturbance of the normal resonance, which in turn results in a disturbance of the voice.

These patients, through the constant use of their high voices, make permanent the misdirected action of their phonatory muscles. The larynx remains high up in the throat. The movement of the true and false vocal cords is interfered with. The free vibratory edges of the true vocal cords become reduced to about half the normal length, giving a short string, which always produces a high note. The false cords sag through diminished tension. The size of the ventricles of the larynx becomes reduced, thereby reverting to the original boy or girl size and producing a change in resonance.

A sensitively organized child, especially a boy, is rather surprised and shocked at his initial changes of voice when he is passing through his period of mutation. He tries to continue to speak as he was accustomed to hear himself. This is one manifestation of a series of conflicts

between forces impelling him toward maturation of emotional development and others forcing him to maintain the status quo or to remain fixed at the same level. The latter forces may be his own feelings of doubt and inadequacy regarding his ability to attain the often highly exaggerated state of masculine maturity. This is especially so if he has been subjected to jeering comments regarding his physique or his peculiar vocal efforts during the period of mutation. These fears and doubts, coexisting with other emotional conflicts, and the defenses built up against them during this period of mutation have been aptly called the masculine protest. Often these neurotic conflicts lead to compensations and overcompensations in some other sectors of the personality, as for example the intellectual. One fact remains, however, that the main structure of the personality is warped or neurotic.

It is in this sense that the three types of abnormality—stuttering, hysterical aphonia and falsetto voice—although symptomatically different, end alike. The sufferers from all these conditions acquire neurotic characters or personalities.

A word about prognosis. The main determinant in the prognosis in all these abnormalities is the degree of healthy personality that the patient presents. The usual order of severity of symptoms, hence also of prognosis, is as follows: stuttering, falsetto voice and hysterical aphonia. The first is the most severe, since the onset of stuttering is almost always in childhood (in the majority of cases the abnormality starts at or before the age of 6 years), so that much less healthy emotional development was attained before the onset of the neurosis. The person with a falsetto voice has the advantage of having had a foundation of healthy emotional development up to the age of puberty before the onset of the disturbance, hence he is in a better position to react in a milder manner, having had the opportunity to establish healthy emotional patterns over a longer period. The hysterical person has the further advantage of a still later date of onset and by the same token a still longer duration of healthy emotional functioning, furthermore, the very nature of the precipitating circumstances is different in that these circumstances are usually situational, in contrast to those in the cases of falsetto voice, in which the precipitating factors are physiologic organic changes.

The treatment of all these conditions falls into two categories. The treatment of dysphemia, or stuttering, owing to the severity and chronicity of the disorder, must be of a highly specialized nature, extended over a long period. Furthermore, as previously pointed out, consideration of the total personality, both physically and psychically, is paramount. This can be brought about only through a special composite therapy. On the other hand, the treatment of hysterical aphonia and falsetto

voice, both of which fall under the heading of dysphonia, requires a relatively shorter and less fundamental therapy. All forms, requiring as they do the application of psychiatric principles, differ in the sense that in the stutterer the main goal of the treatment is development of character—the development of an integrated and more mature personality—while in the cases classed under dysphonia the treatment is more symptomatic and the personality, being less affected, requires a treatment which is less extensive and shorter in duration.

However, persons with falsetto voice and those with aphonia must receive a special form of treatment. These patients usually state, as in the letters quoted, that “the specialist tells me my throat is normal, there is no sign of paralysis, no reason why I cannot speak.” But the fact remains that despite various types of physical therapeutic measures, such a patient often does not get better, because his personality and his musical consciousness are almost completely ignored. Physical aid without psychic understanding is not enough.

A realization of this concept should lead one to establish a composite form of treatment that takes cognizance of all factors. Thus, if the patient is fortunate enough to find the special therapist, that is, a laryngologist who has both musical and psychiatric leanings—in other words, a musical psychiatric laryngologist—desired results can readily be obtained. Such a physician institutes a composite therapy which correlates the psychic and somatic states into an integrated whole, so that the action on the personality is of such a nature that the patient achieves a normal standard of voice and speech.

In conclusion, let me again point out that for all these conditions therapy must be both of a local and of a general nature but it is of the utmost importance that the therapist consider the presenting physical symptom—stuttering, aphonia or paraphonia—as secondary and not as the principal object of treatment. Therapy should be directed toward the person as a whole, the goal being a fundamental change in personality through both a physical and a psychologic approach.

The presentation of several charts and graphs as well as voice and speech recordings of patients before and after treatment demonstrated the Medical-Social Clinic's approach to the problems of dysphemia and dysphonia and its therapeutic procedure.

# IRITIS CAUSED BY ASYMPTOMATIC SPHENOIDITIS WITH ANOMALY OF THE SPHENOID SINUSES

JOEL J. PRESSMAN, M.D.

LOS ANGELES

In 1934 while he was in New York O. H., a man aged 41 at the time of writing, suffered his first attack of iritis. An extensive search for a focus of infection resulted in entirely negative findings. The treatment consisted of local therapy and intramuscular injections of milk, and was followed by gradual improvement and a return to normal but not until the end of three months. Approximately two years later on April 18, 1936, he presented himself to Dr. Samuel Hirshfeld for examination. The night previous he had suddenly suffered intense pain in the left eye, which immediately became "bloodshot," with sudden marked lacrimation, pronounced photophobia and blurring of vision. He was referred to Dr. Maurice Beigelman, an ophthalmologist, who reported the left pupil to be contracted, with marked pericorneal congestion, cells within the aqueous and reduction in visual acuity to 20/50. The diagnosis was acute iritis.

It was felt that the iritis was secondary to a focus of infection. Smears of material from the prostate gland contained no cells or organisms. Roentgenograms showed that the teeth were entirely normal. Nothing in the general physical examination suggested a possible focus. Examination of the ear, nose and throat gave entirely negative results. The tonsils had been well removed, with no recurrence of lymphoid tissue in the fossae. The lingual tonsils were small, atrophic and entirely innocent in appearance. The ears, pharynx and nasopharynx presented no pathologic changes. The nasal mucosa appeared normal, no pus was present in the nasal passages, and none could be found after thorough shrinkage and suction. The sphenoid-ethmoid fissures, as visualized with the nasopharyngoscope, presented no injection or edema.

There was observed a high deviation of the septum toward the right side. The antrums and frontal sinuses transilluminated brilliantly. A careful history elicited no symptoms referable to the nasal accessory sinuses. There had been no nasal or postnasal discharge, headache, obstruction to nasal respiration or sneezing, and no recent infection of the upper respiratory tract.

Roentgenograms of the sinuses presented a definite haziness of the right (contralateral) sphenoid sinus, with general loss of outline. Attempts to irrigate this sinus were unsuccessful owing to the high deviation of the septum.

Because of the severity of the iritis and the failure to demonstrate another focus after thorough search, it was determined to explore the right sphenoid sinus surgically. This operation was performed on the night of April 18, 1936, with cocaine anesthesia. The right middle turbinate bone was fractured and displaced away from the midline, after which the front face of the sphenoid became surgically accessible. A Faracé punch was inserted through the region of the ostium, and as much of the anterior wall as possible in all directions was removed with sphenoid punches. A large opening resulted, and the interior of the sinus could be readily visualized. No anatomic variation was noticed. That portion of the

lining membrane which was visible appeared to be intensely reddened and edematous. Cultures resulted in a growth of *Bacillus coli* in large numbers, with numerous colonies of nonhemolytic streptococci and a few colonies of *Bacillus pyocyaneus*.

The postoperative course was uneventful. After twenty-four hours marked improvement in the pathologic condition of the eye had taken place. Pain had diminished appreciably, and the redness, photophobia and lacrimation were much less marked. Forty-eight hours after his admission the patient was discharged from the hospital, steady improvement having taken place. All symptoms had almost disappeared, and there was a minimum of injection of the pericorneal vessels, although cells were still present within the aqueous.

On the third postoperative day there developed a sudden recurrence of all symptoms and signs, perhaps more severe than the original attack. The region of the right sphenoid sinus was filled with a large mass of dried blood clot, fibrin,

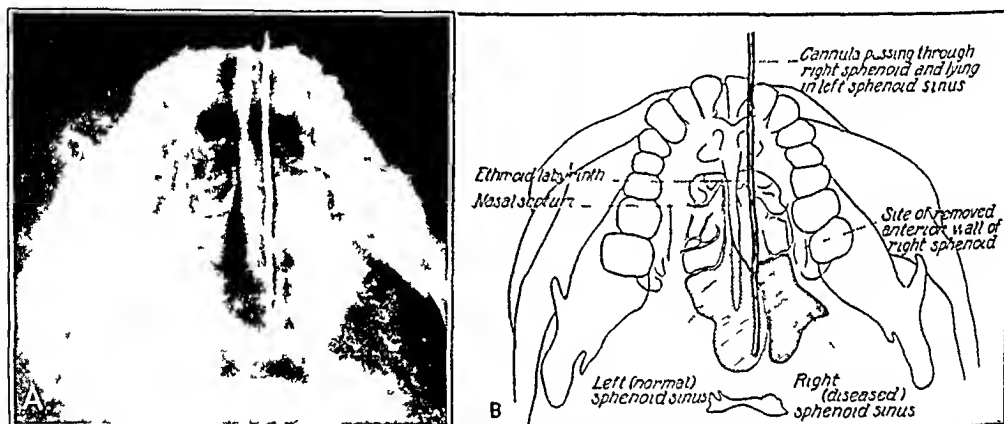


Fig 1—*A*, roentgenogram showing the cannula inserted through the right naris but lying within the left sphenoid sinus. *B*, a diagrammatic reproduction of *A*.

lymphatic exudate and purulent crusts. This was removed as completely as possible by suction with a cannula. The surgical opening in the sphenoid was not visible owing to edema of the surrounding tissues. It was possible, however, to enter the sinus with a large cannula, and irrigation with Ringer's solution was carried out. No pus was obtained, and no improvement in the pathologic condition of the eye resulted, on the contrary, the right eye grew progressively worse. Shrinkage and irrigation of the sphenoid sinus were carried out daily for several days. The return flow was always clear, despite which the iritis continued and apparently became more severe.

Ten days after operation it was noted on irrigating the sphenoid sinus that the return flow came through the *left* nostril, which had not been operated on. It was thought that perhaps an anomalous distribution of the sphenoid sinuses might be present. The cannula was therefore allowed to remain in situ, and roentgenograms were taken of the floor of the skull. This revealed that the irrigating cannula, although inserted through the right naris, was actually lying within the confines of the left, or normal, sphenoid sinus.

Figure 1*A* is a reproduction of this plate. It shows the dividing wall between the two sphenoid sinuses to be considerably to the right of the midline and bowed outward in such a fashion as to protrude farther to the right. Thus,

the posterior part of the right naris is for the most part occupied by the left sphenoid sinus and not by the right

What had taken place at the operation was easily understood. The presenting anterior wall of the sphenoid sinus had been removed almost in its entirety, but this represented actually a wide opening into the left, or healthy, sinus and only a small opening into the right, or diseased, sinus and this in the extreme lateral portion of the area operated on. This small opening into the right sinus was therefore immediately behind the prominence of the middle turbinate and the ethmoid capsule. Such a small opening sufficed for adequate drainage for a time with temporary amelioration of symptoms, but drainage from it soon became inadequate owing to obstruction from the mass of postoperative debris and from edema. When the debris had been cleaned away postoperatively, its removal had not been sufficiently thorough to free the small anatomically inaccessible opening into the right sphenoid sinus, and together with the edema this



Fig. 2—The cannula when bent at the tip comes to lie within the right sphenoid sinus

resulted in retention of pus and recurrence of the pathologic condition of the eye. Apparently, too, portions of the dividing wall between the two sinuses had been bitten away without such removal having been recognized.

The peculiarities of the anatomic distribution having been established and a reasonable conclusion having been reached to explain the disappearance and recurrence of the iritis, further steps in the treatment suggested themselves. From examination of the roentgenograms of the base of the skull it seemed that while a straight cannula could not easily be inserted into the right sphenoid sinus, a cannula curved to the right would slip by the dividing wall into the diseased right sinus. A cannula was accordingly bent, inserted into the sinus and retained *in situ*, and further roentgenograms were taken. This demonstrated that the cannula had actually entered the right sphenoid sinus, as demonstrated in figure 2.

Irrigation was then carried out through this curved cannula, and a large amount of thick, tenacious yellow pus was obtained. Improvement in the iritis, which had by this time become severe, occurred almost immediately. The day following the irrigation injection of the vessels had diminished appreciably and decided amelioration of the subjective symptoms had taken place. The cells in the aqueous became



fewer. Repeated irrigation of the right sphenoid sinus with the curved cannula produced smaller and smaller amounts of pus, and within a few days all symptoms had abated. A constantly diminishing number of cells persisted in the aqueous for perhaps a week or ten days, but then they disappeared. Vision had returned to 20/20, and the patient was discharged as cured.

This case presents many important phenomena. First, there existed sphenoiditis, which was completely asymptomatic. There was no history of nasal or postnasal discharge and no headache. A thorough examination of the nose gave entirely negative results, and yet the sphenoid sinus contained a markedly reddened, distinctly pathologic mucosa. Second, cultures of material from the sphenoid sinus yielded *B. coli* in great profusion, which in itself must be rare. Third, there had apparently been hematogenous spread of infection, causing iritis in the opposite eye. The sequence of events, i. e., the improvement in the iritis following the initial opening of the sinus, the recurrence of symptoms when that opening became blocked and the prompt cure following the reestablishment of drainage from the sphenoid, is a chain of circumstances pointing definitely to a close association between the iritis and the sphenoiditis. Fourth, an anatomic anomaly was directly responsible for inadequate surgical treatment, however, when it was once recognized, adequate treatment resulted in a cure.

While anomalous distribution of the sphenoid sinuses is not rare as observed roentgenologically and in the cadaver, it had not been my experience to observe a case in which the anomaly played so important and dramatic a rôle in the course of pathologic and therapeutic events.

# ACUTE STREPTOCOCCIC EDEMA OF THE LARYNX WITH SECONDARY ATELECTATIC PNEUMONITIS

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The purpose of this paper is to emphasize the seriousness of streptococcic edema of the larynx and the necessity for early recognition and treatment

The condition has been known under various names, such as spasmodic croup, black croup, strangulation croup and laryngeal stridor, and in later days as acute bronchial stenosis, acute bronchitis and laryngitis, laryngotracheitis, nondiphtheritic croup and many other synonyms

Seven years ago a member of the staff of the Montgomery Hospital asked me to visit a patient with him

The boy, 8 years old, was unable to breathe properly, and while he was apparently not very ill, he had a shocked and worried appearance. Owing to his difficulty in respiration I suggested that he be removed to the hospital for care and for immediate surgical intervention if necessary. I accordingly took him to the hospital and placed him in a tent for steam inhalation. Early the following morning he suddenly became cyanosed. Despite a hasty tracheotomy, he died on the operating table. An autopsy was performed. No definite reason was to be seen macroscopically for the death. The report ascribed death to streptococcic laryngitis.

The recent case which caused me to write this paper was observed by me as consultant on Nov 27, 1936, at 7 30 p m. The baby was 9 months old and had been sick for several days. The condition started, according to the physician, as an ordinary cold. Forty-eight hours before I saw the baby, it had shown evidence of dyspnea and obstructed breathing. The physician, thinking this was diphtheritic laryngitis, gave the child two doses of 10,000 units of diphtheria antitoxin six hours apart. The condition grew progressively worse. The physician tried intubation with no success, being unable to insert the tube. I went with him to see the baby. It lay on the bed vainly trying to complete inspiratory efforts. There was no odor, no strident cough and no metallic grunt, just a violent inspiratory effort, with extreme stretching of the muscles of the chest and abdomen on inspiration. I opened the mouth and inserted a laryngoscope. The examination revealed the typical red, angry-looking pharynx, swollen epiglottis and arytenoid-cricoid folds and edema of the adjacent areas, I was unable to see the cords. The diagnosis was acute streptococcic edema of the larynx. The child was brought to the hospital. The roentgen examination revealed complete obstruction of the upper right bronchial tree, with involvement of the

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Read at the Montgomery Hospital, Dec 21, 1936

upper lobe of the right lung to the point of apparent consolidation, or atelectasis. The baby was put in an oxygen tent, and while attempts were being made to have an experienced bronchoscopist come to the hospital, extreme rigor suddenly developed and despite a tracheotomy death occurred suddenly. An autopsy was performed. The observations were extremely interesting, typical and logical. The larynx, trachea and upper portion of the bronchi were swollen, edematous and full of thick fibrinous exudate, and, most significant, "the entire tracheal tree and its rings were obliterated in the macroscopic appearance." The right bronchus was collapsed and swollen. The upper lobe of the right lung was black and absolutely atelectatic. It had been shut off from its air supply. There was no foreign body. A large amount of thick yellow pus had been previously removed during the tracheotomy. A specimen was taken for culture. It proved later to contain a pure growth of streptococci.

The baby no doubt died of acute streptococcic edema of the larynx, trachea and bronchi, with secondary atelectasis of the upper lobe of the right lung. Stenosis and consequent asphyxia were the actual cause of death. The respiration was shut off, and an area of acute fulminating atelectasis developed in the chest, with failure of the respiratory center, asphyxia and consequent death.

The practical points to be considered are diagnosis, inferential and visual, and treatment.

#### DIFFERENTIAL DIAGNOSIS

In reference to diagnosis, one must by inference or inspection rule the condition to be a foreign body, diphtheritic laryngitis, laryngeal stridor or acute fulminating laryngitis, with contiguous pathologic changes and continuity involvement. I should rule out diphtheria for the following reasons:

- 1 Age—diphtheria is rare in persons under 1 year of age
- 2 Lack of odor or appearance of membranes in the fauces (absence of faucial membranes is rare)
- 3 Lack of peculiar metallic cough
- 4 No improvement after injection of antitoxin (therapeutic reason)
- 5 The high temperature—103 to 104 F. This will hardly be present in diphtheria or laryngeal stridor
- 6 Inspiratory effort (typical in cases in which passages are closed off)
- 7 Signs of intense shock

This brings one to laryngeal stridor. This disease, or rather condition, is found in feeble undernourished children, who are flabby and weak and present symptoms which cause one to suspect enlargement of the thymus gland. As a rule, it is common in children under 1 year. Luc, the great French laryngologist, said it is more common in boys. It is regarded as an adductor spasm, and in origin it is probably a stimulation of the recurrent nerve. It is not attended by fever, has a sudden onset with paroxysm, and an expiratory grunt and by

value of its repeated attacks can be distinguished from laryngitis caused by a definite bacterial factor. The attack usually occurs at night, has a great many alarming signs and symptoms and in some cases, if prolonged, may cause suffocation in infants weak and debilitated from pulmonary collapse (Eustace Smith). This is a condition involving the tone of the laryngeal muscles. Increase of tone of the adductor muscles will undoubtedly cause this annoying condition. Inspection, either direct or indirect with a laryngoscope or a mirror will show a pink normal-looking glottis, not swollen, but simply in the throes of an adductor spasm. Mechanical intervention either with a tube or with a bronchoscope will restore the inspiratory capacity and rhythm of the child's breathing. Simply pulling out the tongue may do it.

The adductor muscles bring the cords together by the action of the lateral thyro-arytenoid and cricothyroid muscles, which are supplied by the recurrent laryngeal nerve. The abductor muscles separate the cords by the action of the posterior crico-arytenoid muscles. These muscles are also supplied by the recurrent laryngeal nerve, which is a part of the vagus or the respiratory nerve of Bell.

In regard to the innervation of the smooth muscle of the bronchi, not much is known about the role of the involuntary nervous mechanism. It has been seen through the bronchoscope that stimulation of the vagus nerve constricts the bronchi. Except in the newer knowledge that a substance known as acetylcholine is produced by stimulation of the vagus, not much is known. Braeucker, a German, dissected out the autonomic nerves to the pulmonary area and found that all the parasympathetic nerves before and beyond their ganglions are vagal in their connection and synapse with the posterior and anterior pulmonary plexuses around all the bronchi. The sympathetic nerves do the same thing with the cardiac plexus coming from the stellate ganglions.

The treatment for laryngismus stridulus is mechanical dilation. Obstruction due to foreign body at the larynx or at one of the main bronchi may produce similar symptoms and will also produce all the clinical symptoms of diphtheritic laryngitis, such as increased inspiratory effort and the drawing in of the epigastrium and the suprasternal notch.

The difference between diphtheria and streptococcic infections usually is apparent, for in streptococcic infections the child will be shocked, bluish or cyanotic—particularly the extremities—and the temperature will be high. The real diagnosis is or can be made by inspection with a laryngoscope or, if one is capable, with a bronchoscope. The glottis is closed, the arytenoid cartilages are edematous and the whole area is suffused with the deep, fiery, angry red of acute infection. Here one will recognize whether it is a streptococcic, an influenzal or a mixed infection. A smear will soon tell you. Jackson stated that the mortality for streptococcic infection is 70 per cent. St. Clair Thompson placed it at 80 per cent, others, even higher. The mortality for the other types is small.

## TREATMENT

The treatment of diphtheria is administration of diphtheria antitoxin. In case of streptococcic infection, I believe that one should immediately isolate the patient and put him in a steam tent with the atmosphere saturated with a medicated vapor. Gas therapy should be provided, and one should promote diaphoresis and diuresis with fluids to the saturation point. One of the best treatments is blood transfusion. The patient should be kept quiet and at rest and in a moist, heavy atmosphere. Streptococcus serum is of value in some cases, and no doubt it should be used. It does not compare in its efficacy with diphtheria antitoxin in diphtheria. Tracheotomy with suction is the most important life-saving procedure, the technical details should be left to one who knows how to proceed with it. Certain medicines are useless. Jackson condemned opium and its derivatives and atropine, as they help to dry up secretion and defeat the main purpose, which is to get air into the lungs and encourage respiration.

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# USE OF THE BENZEDRINE INHALER FOR CHILDREN

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PHILADELPHIA

In the present study an attempt was made to determine (1) the feasibility of administering benzedrine to children by dry inhalation, (2) the therapeutic effect of such inhalation and (3) the possible occurrence of toxic effects.

Children under treatment in the outpatient department of the Children's Hospital of Philadelphia were selected. Seventy-five were suffering from acute rhinopharyngitis and sinusitis and twenty-five from acute otitis media with rhinopharyngitis. Two children with asthma and two with epistaxis also were treated. The ages varied from 1 to 12 years.

For the older children, the method advised for the use of the inhaler was similar to that described for adults. These children were able to use the inhaler satisfactorily and with apparent good results. For the younger children and for infants the parents were instructed to insert the inhaler into each nostril and allow one deep inspiration (during crying) hourly. In those instances in which the mother would cooperate this technic was satisfactory. Before the inhaler was given for home use, the technic was demonstrated to the mother in the clinic. Care was taken to choose families who would cooperate in every respect.

In each case observations were made in the clinic before and fifteen minutes after the use of the inhaler to determine its immediate effect. In a typical case prior to the use of the inhaler there were edema and congestion of the nasal mucous membrane with mucopus in both meatuses and in the nasopharynx. In most instances the child had obstructed breathing. The inhaler was then employed three times at five minute intervals, and the nose and throat were again examined. It was found that after the use of benzedrine there were marked shrinkage and blanching of the nasal mucosa and increased drainage from the meatuses, often producing an increase in the postnasal discharge. (The children between 3 and 12 years of age "hawked up" and expectorated the mucus from the pharynx.) This increased drainage was associated with freer passage of air through the nose and relief from the "stuffiness."

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This study was aided by a grant from Smith, Kline and French.

In no case was any ill effect noted by the examiner or reported by the parents from the use of the benzedrine inhaler. Headache was not complained of, and sleeplessness and restlessness were not encountered. No gastro-intestinal disturbance, as is sometimes noted after the use of ephedrine compounds, was observed.

In all the seventy-five cases of acute rhinopharyngitis and sinusitis, more or less relief from the obstructive symptoms was apparent. In each instance the mother seemed highly pleased with the results.

In the twenty-five cases of acute otitis media the inhaler did not seem to alter definitely the course of the disease, but it did help in relieving the nasal symptoms.

In the two cases of asthma the nasal obstructive symptoms were relieved. In the two cases of epistaxis due to bleeding in Kisselbach's triangle in which the inhaler was used in an attempt to produce vasoconstriction, it failed to influence the bleeding.

#### SUMMARY

It was found that the benzedrine inhaler can be satisfactorily employed for young children for the relief of obstructive symptoms in the nasopharynx due either to infection or to allergic edema. No untoward symptoms were noted from the use of the inhaler.

# ACUTE LABYRINTHITIS WITH COMPLICATING LATE FACIAL PARALYSIS

## REPORT OF A CASE

ANDERSON HILDING, M D

DULUTH, MINN

The following case seems worthy of a report because of late facial paralysis after an operation on the labyrinth due to the formation of a sequestrum

## REPORT OF CASE

*History*—A 6 year old girl became ill, with vertigo and earache on the right side, on the afternoon of May 28 1935. She had apparently been well during the forenoon except for a slight cold. This was not her first attack of otitis. In fact, she had been subject to repeated attacks for two years preceding a tonsillectomy in the summer of 1934. She had had no attack since the tonsillectomy until the present one.

The pain and vertigo continued through the night, making sleep impossible. The same symptoms, with vomiting added, continued all day on May 29. She was first examined by me at 6 p. m. of that day. The chief findings were moderate fever, marked tenderness over the mastoid, marked rotatory nystagmus toward the left, much pus in the external canal, a red and swollen ear drum and signs of acute infection of the respiratory tract in the nose and throat.

Hearing was present in the right ear but was much reduced.

A diagnosis of acute mastoiditis with complicating serous labyrinthitis was made.

Since the duration of the entire attack had been only one day, it was decided to encourage drainage from the ear and to await developments until the following morning.

The mother, calling by telephone at 6:30 a. m. on May 30, reported that the symptoms had not subsided, so it was arranged that the child be brought to the hospital for immediate operation.

Another examination was made an hour later. It was found then that the labyrinth was dead to all tests (tuning forks, voice and caloric) and that there was slight but definite stiffness of the neck. The temperature was 102 F. The mastoid and aural findings were unchanged. A spinal puncture was done, and the fluid pressure found to be 6 mm. The fluid was cloudy, the Nonne-Apel't reaction was positive, and the cell count was 800.

It was apparent that the labyrinthitis had reached the suppurative stage, that meningitis was already beginning and that the patient's welfare demanded immediate operation on the labyrinth.

*Operation*—The labyrinth was drained according to the technic of Neumann. The lateral sinus was encountered with the first cut of the chisel into the cortex close behind the external canal. It was not until this happened that it was noticed that the sinus lay so close to the surface that its course could be followed on the outside of the skull as a faint blue band. The anterior position of the sinus made the subsequent dissection on the labyrinth difficult. The mastoid was found to



be acutely inflamed throughout, with little softening of the bone and little pus. A little pus was found around the sigmoid sinus. The middle fossa was opened, and the dura was found to be normal.

After the labyrinth had been drained, the dura of the posterior fossa was laid bare medial to the sinus and opened by means of a crucial incision. Much fluid escaped. A bothersome little bleeding vessel was encountered in the dural incision that probably accounted for the blood subsequently found in the spinal fluid.



Fig 1—Facial paralysis which developed twenty-seven days after an operation for suppurative labyrinthitis with complicating meningitis.

A second operation revealed the fact that a portion of the labyrinthine capsule, including a part of the facial canal, had sequestered. The resulting formation of pus had blocked the nerve.

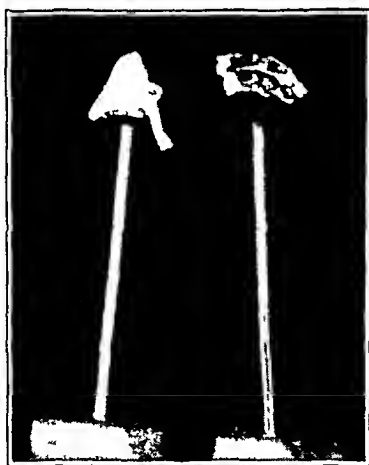


Fig 2—The sequestrum found at the second operation mounted on an ordinary pin, as compared in size with the incus from the same ear.

The upper groove in the sequestrum is a portion of the wall of the horizontal semicircular canal, while the lower groove is a portion of the facial canal.

Movements of the face began four days after the removal of this sequestrum.

The operation was concluded, leaving the radical mastoidectomy incomplete as far as the plastic operation on the canal was concerned. It was deemed wiser to wait for that until some later date.

*Postoperative Course*—For two or three days there was a tremendous leakage of spinal fluid through the dressings

Spinal puncture was done on each of the first three postoperative days. The fluid was faintly red and slightly cloudy each day, and the cell counts were, respectively, 900, 950 and 1,890. Differential counts revealed the interesting fact that most of the cells were red blood cells and that the leukocyte count was actually dropping rapidly. In the three specimens the leukocyte count was 250, 95 and 19, respectively.

Convalescence was rapid and otherwise uneventful until the twenty-seventh day, when it was noticed that there was weakness of the right side of the face. By that time the patient had been home from the hospital and running about for some time. This weakness became more pronounced until the thirtieth postoperative day, when paralysis was complete.

It was decided to explore the facial nerve for the cause of the nerve block.

*Operation on the Facial Nerve*—On June 29 the mastoidectomy wound was reopened and cleaned out. The facial canal was exposed from below upward but had not yet been opened when a loose bit of sequestered bone was encountered. It lay where the labyrinthine capsule had been tunneled under the facial canal to drain the vestibule (between the horizontal and the posterior semicircular canal). There was an accumulation of pus in this tunnel. The sequestrum included what remained of the horizontal semicircular canal and half of the contiguous portion of the facial canal. When it had been removed, the facial nerve lay exposed on its superior aspect.

The occasion was taken to complete the radical mastoidectomy by doing a plastic operation on the canal.

*Postoperative Course*—Convalescence was rapid and uneventful. The cavity healed rapidly and completely and remained dry.

Facial movements began on the fourth postoperative day, and by the ninth day they seemed to be entirely normal.

Cultures of pus obtained at the first operation contained streptococci.

Pus from the second operation yielded no bacterial growth.

# Progress in Otolaryngology

## Summaries of the Bibliographic Material Available in the Field of Otolaryngology

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### TUMORS OF THE NOSE AND THROAT

GORDON B. NEW, M.D.

ROCHESTER, MINN.

AND

WALTER KIRCH, M.D.

DES MOINES, IOWA

#### GENERAL CONSIDERATIONS

Torrigan and Palumbo<sup>1</sup> reported the results of treatment by irradiation of malignant tumors of the upper respiratory passages. After years of experience they continue to prefer treatment by radium to that with roentgen rays. They make use of surgical operation to facilitate the application of radium. Thirty-six tumors involving the nose and paranasal sinuses, 30 involving the nasopharynx, 88 involving the pharynx and tonsils, 32 involving the hypopharynx and 30 involving the larynx were listed, with the type of treatment and results. They stated that the cases considered by many as the most favorable for surgical intervention are also the most favorable for radium therapy. They prefer to irradiate the metastatic lesions rather than expose the patient to extensive block dissections.

Eigler and Koch<sup>2</sup> reported 8 cases of reticulo-endothelial sarcoma, 5 tumors of the tonsil, 1 of the nasopharynx and 2 arising in the cervical lymph nodes. They discussed the differential diagnosis from lympho-epithelioma. Clinically, the distinction is very difficult to make, histologically, accurate technic and study are necessary to make the diagnosis. They found a great difference in the amount of differentiation and malignancy of the lesions in their cases, but irradiation therapy continued to be the treatment of choice.

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From the Section on Laryngology, Oral and Plastic Surgery, the Mayo Clinic

1 Torrigan, C., and Palumbo, V. Radiumterapia dei tumori maligni delle prime vie respiratorie, *Ztschr. f. Hals-, Nasen- u. Ohrenh.* **40** 44-133, 1936

2 Eigler, Gerhard, and Koch, Johannes. Die Retothelsarkome (Morphologie, Klinik und Strahlensensibilität), *Arch. f. Ohren-, Nasen- u. Kehlkopfh.* **140** 278-308 (Jan.) 1936

# NOSE AND SINUSES

Kramer and Som<sup>3</sup> reported in detail 5 cases of true papilloma of the nasal cavity observed in their practice. They collected 81 cases reported in the literature in which they classified the lesion as belonging to this rather rare disease entity. They expressed the belief that three other pathologic types of nasal neoplasm frequently have been mistaken for true papilloma. These are (1) mucous polyp of the common inflammatory type, (2) cutaneous wart, which arises in the vestibule of the nose, especially in the septum and (3) papillary carcinoma. None of these should be confused with true papilloma, or papilloma dura, which is a purely epithelial growth, usually arising from the accessory sinuses or the deeper parts of the nasal cavity, and characterized by grayish red, lobulated, villous, easily bleeding masses spread over a large surface. These have a great tendency to recur and not infrequently undergo malignant transformation. Kramer and Som have found surgical diathermy of great advantage in the removal of these growths because of the easier control of hemorrhage. They expressed the belief that the tendency to recurrence is attributable to incomplete removal but also may be a result of the tendency of the mucosa to form these growths. A positive diagnosis can be made only by removal of a specimen for biopsy. They expressed the belief that the treatment of choice is thorough surgical removal followed by radium therapy.

Robinson<sup>4</sup> briefly reported his results in the treatment of malignant tumor of the nasal sinuses. He found that roentgenologic examination is of little help in the diagnosis and that the condition was diagnosed late in many cases because exploratory maneuvers were not performed. He advocated radiation therapy for all active types of growth. He found, however, that surgical drainage is often indicated when infection is present and to render the growths more accessible. In a series of 60 cases, in most of which the process was far advanced, there were 12 patients (20 per cent) who were well for five years and 15 (25 per cent) who were well for three years.

Geschickter<sup>5</sup> examined and classified microscopically 211 tumors removed from the nose, nasopharynx and paranasal sinuses at the Johns Hopkins Hospital. This series included almost every known type of benign or malignant growth to be found in this region. He described the pathologic picture of each type briefly but clearly. The article is well worth reading. There were 19 benign epithelial tumors,

3 Kramer, Rudolph, and Som, M. L. True Papilloma of the Nasal Cavity, *Arch Otolaryng* **22** 22-43 (July) 1935

4 Robinson, G. A. Diagnosis and Treatment of Malignant Tumors of the Nasal Sinuses, *Am J Roentgenol* **34** 641-643 (Nov.) 1935

5 Geschickter, C. F. Tumors of the Nasal and Paranasal Cavities, *Am J Cancer* **24** 637-660 (July) 1935

among which were included salivary mixed tumors usually regarded by pathologists as malignant, 139 malignant epithelial tumors, 37 benign connective tissue tumors and 16 malignant connective tissue tumors. An extensive bibliography is appended.

#### NASOPHARYNX

Schinz and Zuppinger<sup>6</sup> reported briefly 26 cases of malignant tumor of the nasopharynx in which treatment was given between 1930 and 1936 by protracted fractional roentgen therapy. Sixteen of the tumors were carcinomas, for the most part lympho-epitheliomas, the remainder were sarcomas. The average age of the patients was 43½ years, the youngest was 15. Only 5 were women. None survived into the fifth year after treatment was begun.

Koch and Eigler<sup>7</sup> reported 6 cases of nasopharyngeal fibroma, in 2 of which the lesion involved the paranasal sinuses, in which treatment by a combination of radium and roentgen rays was successful. There were no untoward effects on the normal tissues. The time required for complete cure was about one and one-half years. They expressed the belief that this is the treatment of choice.

Baumann-Schenker<sup>8</sup> reviewed 29 cases of lympho-epithelioma of the upper air passages. In 23 the epithelioma was primary in the nasopharynx, and in 3 in the tonsil, in 2 cases it was in the hypopharynx and in 1 it was found in the trachea, the place of origin being doubtful. These cases were observed and treatment was applied between 1928 and 1935. The treatment consisted in roentgen therapy by the protracted fractional method. After the completion of the treatment careful examination frequently revealed the persistence of a "rest-tumor," which was difficult to eradicate. This remnant of tumor frequently could not be demonstrated by nasopharyngoscopy, but its presence was revealed on removal of a specimen for biopsy or on the use of iodized poppy-seed oil and roentgen examination by Zuppinger and Ruedi's method.

Martin<sup>9</sup> discussed the treatment of carcinoma of the pharynx and nasopharynx by irradiation. He has adopted a modification of the Coutard roentgen ray technic, which has shortened the periods of treat-

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6 Schinz, H. R., and Zuppinger, Adolf. *Zürcher Erfahrungen der Radiotherapie bei bösartigen Epipharynx-tumoren*, *Ztschr. f. Hals-, Nasen- u. Ohrenh.* **41**: 173-177, 1936.

7 Koch, Johannes, and Eigler, Gerhard. *Beiträge zur Strahlenbehandlung der Basalfibroide*, *Arch. f. Ohren-, Nasen- u. Kehlkopfh.* **142**: 1-14 (Oct.) 1936.

8 Baumann-Schenker, Rudolf. *Ueber das lymphoepitheliale Karzinom*, *Zürcher Erfahrungen aus den Jahren 1928-1935*, *Strahlentherapie* **55**: 369-386, 1936.

9 Martin, C. L. *Carcinoma of the Upper Pharynx*, *Am. J. Surg.* **30**: 36-54 (Oct.) 1935.

ment, making it possible to treat a larger number of patients. In some cases he combined roentgen therapy with the interstitial implantation of radium by Quick's method. Reports of cases were given.

#### PHARYNX

Woodward<sup>10</sup> reported a case of cavernous hemangioma involving the palate, pharynx, larynx and esophagus. Dark red, irregular, non-pulsating masses which were compressible were seen in these structures. Diagnosis was confirmed by removal by surgical diathermy of a specimen from the uvula for biopsy. The chief complaint was of recurrent and increasingly severe hemorrhage. Radium packs were applied, the masses diminished in size and the hemorrhages ceased. Woodward reviewed the scanty literature on this rare condition and concluded that whereas these tumors are essentially benign they are dangerous to life when situated in the larynx and pharynx because of their proneness to hemorrhage. Surgical removal may be performed but is dangerous. Radium packs are considered the treatment of choice.

Edling<sup>11</sup> reported the early results of treatment by means of the telerradium gun in 8 cases of cancer of the larynx and 10 cases of cancer of the hypopharynx. He noted that the reaction to this type of treatment is less marked than that to the protracted fractional method of roentgen therapy. Five patients who had cancer of the larynx had been well from ten months to three and one-fourth years after treatment at the time of writing, of the second group 4 patients had been well for periods varying from one and three-fourths to three and three-fourths years. A description of the technic employed was given.

Salinger and Pearlman<sup>12</sup> reviewed a series of 24 cases of malignant tumor of the epipharynx. With the purpose of simplifying the existing confusion as to the classification of tumors of this region, they submitted specimens removed for biopsy from these patients to three different pathologists, who almost unanimously made a diagnosis of transitional cell epithelioma in 75 per cent of the cases, in 8 per cent the diagnosis was sarcoma. The remainder received varying diagnoses. Lympho-epithelioma was diagnosed 6 times, two of the pathologists agreeing on this diagnosis in only 1 instance. Endothelioma, formerly diagnosed frequently, was named once by one pathologist. Salinger and

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10 Woodward, J. F., Jr. Cavernous Hemangioma of the Hard and Soft Palate, Anterior and Posterior Pillars of the Pharynx and the Larynx, *Laryngoscope* **46** 32-41 (Jan.) 1936.

11 Edling, Lars. Primary Results of Telerradium Treatment in Cancer of Larynx and Hypopharynx at the Radiologic Clinic of the University of Lund 1931-1933, *Radiology* **25** 267-273 (Sept.) 1935.

12 Salinger, Samuel, and Pearlman, S. J. Malignant Tumors of the Epipharynx, *Arch. Otolaryng.* **23** 149-172 (Feb.) 1936.

Pearlman reviewed previous statistics and noted the great discrepancy in the pathologic conditions reported. The greatest similarity to their own observations was noted in the reports of one of us (G. B. N.) (Broders' classification) and Ewing. The pathologist consulted by Salinger and Pearlman had great difficulty in differentiating transitional cell epithelioma and lympho-epithelioma. A summary of their case histories was given from which cervical adenopathy, otalgia, other symptoms referable to the ear and pain due to involvement of the fifth cranial nerve appeared to be the most frequent symptoms. The symptomatology and treatment were discussed briefly, and the results of 6 postmortem examinations were given. Some clear photomicrographs accompanied the article.

One of us (G. B. N.)<sup>13</sup> reported 2 additional cases of xanthoma (2 had been reported by him in 1932) involving the upper air passages. In the first case there were many small xanthomatous patches in the pharynx and on the palate, vallecule and epiglottis as well as one nodule in the subglottic region. There was scarring of the arytenoid cartilages and epiglottic region which had caused a ringlike thickening. The patient complained of some difficulty in swallowing. This patient also had pernicious anemia. The second patient's only symptom was increasing hoarseness. On examination a yellowish tumor involving the posterior two thirds of the left true and false vocal cords was found. Thyrotomy was performed, and the tumor was removed with the aid of surgical diathermy. No recurrence was noted a year later. Examination of the tissue in both cases revealed the typical appearance of xanthoma. The obscure etiology of this condition, suspected to be connected with a metabolic disturbance, and its pathologic picture, course and treatment were discussed. No treatment has been found to give definite results.

Berven<sup>14</sup> reviewed the results of treatment of malignant tumors of the mouth and pharynx at Radiumhemmet, Stockholm, Sweden, with his usual thoroughness. The treatment consisted almost exclusively of teleirradiation with Sievert's apparatus, brachyirradiation (interstitial placing of needles and surface applications), electrocoagulation and surgical removal of operable metastatic lesions. The technic was described in detail for certain cases, stress being placed on the necessity of sparing the supporting stroma if good results are to be expected. Thirty-nine persons with carcinoma and lympho-epithelioma of the tonsil were treated between 1923 and 1930, 16 (41 per cent) of the patients had remained free from symptoms for five years or more at the time of writing.

<sup>13</sup> New, G. B. Xanthoma of the Pharynx and Larynx, *Arch. Otolaryng.* **22**: 449-453 (Oct.) 1935.

<sup>14</sup> Berven, E. G. E. Die radiologische Behandlung von malignen Tumoren in Mundhöhle und Mesopharynx, *Ztschr. f. Hals-, Nasen- u. Ohrenh.* **40**: 1-14, 1936.

On reviewing the results obtained in the treatment of 89 patients with carcinoma of the hypopharynx between 1921 and 1926 (8, or 9 per cent, of the patients still survive) Coutard<sup>15</sup> stated that in this region the best results are to be expected with noninfiltrating tumors, for instance, most tumors of the vallecula and the glossopharyngeal sulcus. He found that increase of the dosage of roentgen rays does not improve the results and may prove disastrous because of the destruction of the supporting stroma. Better results are to be obtained by lengthening the time of administration. He stated that the infiltrating types of growth alter the supporting tissues rendering them more susceptible to damage by the radiation. When one is dealing with this type of growth protection of the surrounding stroma is more important than actual destruction of the growth.

Maisin and Vassiliadis<sup>16</sup> reported in detail the results of treatment at the Louvain Cancer Institute of 154 patients with cancer of the pharynx or oral cavity in nine years. In 53 cases the lesion involved the larynx, in 51 the tonsils and tonsillar pillars and in the remainder the floor of the mouth and the tongue. Treatment consisted of roentgen therapy by a modification of Coutard's method, teleirradiation and moulage. The last-mentioned method of treatment was abandoned in later years. A combination of irradiation and surgical therapy was employed when there were metastatic lesions which could be removed. Maisin and Vassiliadis' results compare favorably with those of other large clinics, more than 11 per cent of their patients having survived more than seven years. The most interesting feature of their treatment is the administration of small doses of barium by mouth as a catalytic agent. This treatment which was tested in mice first, when adopted and used for human beings caused an improvement of from 15 to 40 per cent in the results obtained over those obtained in a series of cases in which this treatment was not employed.

Kisfaludy<sup>17</sup> described the treatment of malignant tumor of the tonsil. Surgical diathermy was used in some cases but only superficially. The main treatment consisted in interstitial irradiation by means of especially long needles containing from 2 to 66 mg of radium. This treatment was combined with surgical removal of the regional lymph nodes, roentgen therapy and moulage. Forty inoperable and 32 operable tumors were treated. There was no operative mortality. Kisfaludy

<sup>15</sup> Coutard, H. Ueber Rontgentherapie der Pharynxkarzinome, Strahlentherapie **52** 1-10, 1935

<sup>16</sup> Maisin, J., and Vassiliadis, H. Ueber die Behandlung der Mundhohlen-und Hypopharynxkrebse, Strahlentherapie **54** 193-215, 1935

<sup>17</sup> Kisfaludy, P. Ueber die kombinierte Behandlung des Tonsillenkrebses, Strahlentherapie **55** 429-442, 1936



found that local recurrence is rarely the cause of ultimate death. The most frequent causes of death among his patients were cachexia and distant metastasis.

Cade and Allchin<sup>18</sup> reported 52 cases in which carcinoma of the pharynx and hypopharynx were treated by a combination of roentgen rays and the radium bomb. They expressed the belief that this combination permits more effective treatment with less serious damage to the tissues. They maintained that tumors which are no longer affected by a given wavelength may be sensitive to other wavelengths. They divided the growths into four groups according to situation as follows: those of the epipharynx (by which they mean the aryepiglottic folds, arytenoid cartilages and epiglottis and not the nasopharynx), those of the posterior and lateral pharyngeal walls, those of the pyriform fossa and those of the postcricoid region. The technic of treatment varied according to situation and the type of tumor, which they judged more by its appearance than by the histologic report. Of the 52 patients treated, 17 had remained well for periods up to three and one-half years at the time of writing. The technic of treatment was described: a radium bomb containing 2 Gm. of radium was used, but Cade and Allchin expressed the belief that doubling this quantity will produce better results.

#### LARYNX

A method for the conservative surgical treatment of carcinoma involving the anterior portion of the larynx on both sides was described by Patterson<sup>19</sup>. A skin flap shaped like a question mark is made, with the convexity turned toward the side on which the growth is most extensive, with the view of avoiding fistulous openings. The cartilage is bitten away with a forceps. Before the cavity is entered, a tracheotomy is performed and the endomucosa is opened well wide of the visible lesion. Liberal use of the endothermic knife is advised. The author advocated this operation as being more flexible than the usual hemilaryngectomy and stated that although the indications for it are of necessity extremely limited it may be performed in a few cases in which thyrotomy would not be radical enough and laryngectomy too radical. He has performed this operation in 7 cases, with five year cures in 42 per cent. Two of the patients who did not survive five years did not die of a recurrence.

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18 Cade, Stanford, and Allchin, F. M. Combined Distance Radiation of Hypopharyngeal Cancer, *Lancet* **2** 652-656 (Sept. 21) 1935.

19 Patterson, Norman. Carcinoma of the Larynx. A Plea for More Conservative Surgical Procedures in Certain Cases, *Arch. Otolaryng.* **23** 295-305 (March) 1936.

New and Figi<sup>20</sup> discussed the various types and situations of malignant tumor, both intrinsic and extrinsic, involving the larynx and their treatment. A short description was given of the various procedures in use at the Mayo Clinic in the treatment of these conditions. A more exhaustive description was given of their technic of laryngectomy. In a recent review of 135 consecutive operations for carcinoma of the larynx—75 thyrotomies and 60 laryngectomies—it was found that only 1 death had occurred in the series. On reviewing 107 cases in which operation was performed prior to 1929, they found that five year cures were obtained in 82.3 per cent of the cases in which thyrotomy had been performed and in 56.1 per cent of the cases in which laryngectomy had been performed.

Two hundred and two consecutive cases of carcinoma of the larynx observed at the Collis P. Huntington Memorial Hospital in Boston in the period between 1919 and 1933 were reviewed by Garfin.<sup>21</sup> A good history of this branch of laryngology was given, with a critical review of the treatment by surgical procedure and irradiation. Seven patients underwent total laryngectomy, and 3 survived for periods varying from three to four years. Laryngotomy or laryngofissure was performed in 12 cases, with 1 operative death. Of the remaining 11 patients, 4 survived from five to fifteen years. In 20 cases treatment consisted of a combination of surgical operation and irradiation, 5 patients survived more than three years. Thirty-three patients were treated with radium. In many of these cases the carcinoma was extrinsic at the time of examination. The average survival of the patients was only six months. There was 1 death three days after the insertion of radon seeds. Thirty-seven patients with advanced carcinoma were treated with roentgen therapy alone. Only 4 survived a year or more. Forty were treated by combined radium and roentgen rays. Twelve patients in this group survived more than one year, and 1 more than five years. There was 1 death shortly after treatment. Nineteen patients received no treatment. It appears from Garfin's article that early operation still offers the best chance for a permanent cure. The necessity for early diagnosis was stressed.

Hautant<sup>22</sup> discussed the relative merits of irradiation and surgical operation in the treatment of intrinsic cancer of the larynx, he based his remarks on his personal experience in 200 cases in which operation was performed and 122 cases in which the treatment was under the

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20 New, G. B., and Figi, F. A. Treatment of Carcinoma of the Larynx, *Surg., Gynec. & Obst.* **62**:420-423 (Feb. 15) 1936.

21 Garfin, S. W. Cancer of the Larynx. A Study of Two Hundred and Two Cases with End Results, *New England J. Med.* **213**:1109-1123 (Dec. 5) 1935.

22 Hautant, A. La radiothérapie des cancers intra-laryngés. Ses indications et celles de la chirurgie, *Ztschr. f. Hals-, Nasen- u. Ohrenh.* **40**:15-29, 1936.

supervision of Coutard at the Curie Institute in Paris, France. He concluded that the choice of method must depend on an accurate study of each case. The type, extent and situation of the growth are equally important in making this choice. He divided cancers of the larynx into three types—that tending to grow toward the surface, which is amenable both to surgical treatment and to radiotherapy, that tending to infiltrate deeply, which usually responds more favorably to a surgical procedure, and that spreading along the surface, which responds more favorably to irradiation. According to their histologic characteristics, he divided the growths into epidermoid, intermediary and undifferentiated types (the first type is radioresistant, the last two are sensitive to radiation), but he warned that a single specimen removed for biopsy may not give an accurate clinical picture of the entire growth. He divided the tumors according to location as follows: (1) cancer of the vestibule involving the false vocal cords and the epiglottis and extending gradually to the other side and into the pyriform sinus (for this type treatment by irradiation is preferable), (2) cancer of the ventricle of Morgagni, which tends to extend into the subglottic region (for this type total laryngectomy is the preferable treatment), (3) cancer of the vocal cords (this type responds equally favorably to surgical procedures, frequently conservative and to irradiation, but Hautant preferred surgical measures), and (4) cancer of the subglottic region (this type responds better to surgical methods). He stressed the value of roentgen study in the determination of the extent of the tumor. He considered pulmonary tuberculosis, cardiac insufficiency and advanced age as contraindications for surgical intervention. He has experimented in combining irradiation and surgical therapy, and he expressed the belief that with the constant advances in the technic of the irradiation this combination will improve the results of treatment. Irradiation is given before surgical intervention is undertaken to sterilize the outlying parts of the tumor rather than to destroy it totally. Healing is somewhat delayed when irradiation has preceded surgical intervention but no serious disadvantage was noted.

Von Lenart<sup>23</sup> reported 129 cases of epithelioma of the larynx and 1 of sarcoma of the larynx in which surgical treatment was given at the Budapest University Rhinolaryngologic Clinic. There were 33 thyrotomies and laryngofissures, 1 of which was performed on a patient suffering from sarcoma of a vocal cord. There were no deaths. Recurrences appeared in 5 cases (15 per cent), 22 patients (66 per cent) had been well from three to thirteen years when the report was written. Von Lénart always packs the larynx tightly for eight to twelve days.

<sup>23</sup> von Lenart, Zoltan. Zur chirurgischen Behandlung des Kehlkopfkarzinoms, *Acta oto-laryng* **22** 83-104, 1935.

to avoid postoperative hemorrhage inhalation of saliva and so forth. It is customary to remove the lymph nodes above the conus elasticus and along the jugular vein. In 4 cases of recurrence operation was successful. A subperichondrial resection of the larynx was performed in 17 cases. This operation performed with the help of the galvanocautery is indicated when the growth extends slightly into the subglottic region but not beyond the vocal process posteriorly and does not penetrate through the cartilage. At the time of writing there had been 2 deaths and 1 recurrence and 3 patients had been well for more than three years. Hemilaryngectomy was performed in 20 cases. The indication for this type of operation is the involvement of the entire side of the larynx provided it does not extend across the midline posteriorly or into the epiglottis. Billroth's technic was followed. There were 3 deaths (15 per cent) and 6 recurrences (30 per cent). Nine patients (45 per cent) were well for three to fourteen years. Total laryngectomy was performed in 56 cases. The technic followed was that of Gluck and the operation was almost always performed in one stage. The dissection was carried out from below upward in cases in which the tumor was completely intrinsic and from above downward when it extended into the pharynx or the entrance to the larynx. In 37 cases the lesion was intrinsic, there were 4 deaths (10.8 per cent) and 15 recurrences (40.5 per cent) and 12 patients (32.5 per cent) were well for more than three years. In the 19 cases in which the tumor was extrinsic there were 5 deaths (26 per cent) and 8 recurrences (42 per cent) and 4 patients were well for more than three years (21.3 per cent). In 8 of the instances of recurrence the lesion was around the tracheal opening; in the others it was in the lymph nodes. Four patients with small growths of the epiglottis or the introitus of the larynx were operated on by the median transthyroid route. The mortality with this type of operation is far less than that with the subhyoid approach.

Falk<sup>24</sup> reported a case of tumor of the subglottic region in the larynx of a baby 8 weeks old. This proved to consist of thymus tissue and to be connected by strands through the space between the first tracheal ring and the cricoid cartilage with the thymus proper. Falk compared the findings in this case with those of endolaryngeal tumor of thyroid tissue which is far more common. He found that both types of tumor occur in the same region and for the same reasons which he discussed at length. Both these types of tumor appear at the time at which the normal organ of the same type develops—before birth in the case of the thymus and during puberty in the case of the thyroid gland.

<sup>24</sup> Falk, Paul. Ueber ortsfremde, gutartige Gewebsbildungen Thymus- und Thyreoidagewebe im Kehlkopf. *Arch f. Ohren-, Nasen- u. Kehlkopfh.* **141** 118-132 (July) 1936.

Koch<sup>25</sup> analyzed his results in the treatment of 22 patients with laryngeal papilloma. In 1 case roentgen therapy only was employed, 13 patients were repeatedly treated surgically and then by irradiation and 7 were treated by irradiation immediately after the surgical removal of the papilloma. Koch concluded that papillomas differ in sensitivity to roentgen rays and the treatment should vary accordingly. Those made up of closer-knit, more cellular stroma responded better to irradiation. The best results were obtained with irradiation following surgical treatment, for 100 per cent of the patients were well at the time of writing.

Lambadarides<sup>26</sup> reported the late results following roentgen therapy in 12 cases of laryngeal carcinoma. Six patients were living after an interval varying from thirteen months to nine years, 6 had died after surviving from a few days to three and one-half years. Lambadarides expressed the belief that if it is properly applied, especially early in the course of the disease, roentgen therapy is to be preferred to surgical operation. His technic was described and a good bibliography given.

Jackson and Jackson,<sup>27</sup> in a short but clear article, described their technic for laryngofissure and Babcock's technic for laryngectomy. Their method for removing a growth involving the anterior commissure and the anterior portion of both vocal cords is interesting. They use an electric rotary saw to cut the cartilage and avoid cutting through the internal perichondrium. The internal perichondrium is separated from the cartilage to a point outside the limits of the growth before an opening is made into the cavity. The outstanding feature of Babcock's laryngectomy is the separation of the larynx from above downward and delay of its division from the trachea until the pharyngeal wound has been closed. Jackson and Jackson expressed their conviction of the importance of Broders' method of grading malignant tumor for making a choice of the method of operation and for determining prognosis. They described their criteria in selecting cases and their routine of preoperative and postoperative care. Pneumonia was a rare complication in the cases observed by them, but atelectasis caused by the inhalation of foreign materials was fairly frequent. They recommended bronchoscopy and suction in all cases in which this condition is suspected. They expressed the belief that the newer technic of

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25 Koch, Johannes. Die Bedeutung der Bestrahlungstechnik und des Gewebsaufbaus für den Erfolg der Röntgenbestrahlung von Larynxpapillomen, *Arch f Ohren-, Nasen- u Kehlkopfh* **142** 83-96 (Oct) 1936.

26 Lambadarides, A. Einige Spätergebnisse bei Kehlkopfkrebsen nach Strahlenbehandlung, *Strahlentherapie* **53** 630-650, 1935.

27 Jackson, Chevalier, and Jackson, C. L. Malignant Disease of the Larynx. Its Treatment by Laryngofissure and Laryngectomy, *Am J Surg* **30** 3-17 (Oct) 1935.

roentgen therapy is capable of producing remarkable palliative results and cures and that the indication for this conservative treatment is increasing

#### TRACHEA

Abbate<sup>28</sup> reported a case of sarcoma of the trachea in a girl aged 10 years. Reports of only 3 other similar cases were found in the literature. The tumor was removed through a tracheotomy opening, and radium was later applied directly into the tracheal cavity by means of a special carrier which permitted the passage of air around the tube containing the radium. The child was well a year later. The literature was reviewed.

#### ESOPHAGUS

King<sup>29</sup> reported a case of successful removal of the middle portion of the esophagus for carcinoma in a woman aged 56. The surgical approach was posteriorly through the pleura. An interesting point in treatment was the preliminary artificial pneumothorax, which did away with the sudden shock of opening the pleural cavity in the course of the operation. Negative pressure was reestablished after operation by means of suction applied to the wound. The author expressed the belief that the avoidance of infection is the main requisite for success and advocated oral hygiene as one of the most necessary steps in this direction. Another observation of interest was the fact that the patient was slow to regain weight and strength as long as saliva was allowed to escape from the upper stump of the esophagus and was not utilized.

A case in which a pedunculated squamous cell carcinoma of the upper portion of the esophagus was removed by means of surgical diathermy through the endoscope was reported by Moersch<sup>30</sup>. He expressed the belief that this was the first instance of the use of surgical diathermy in the removal of a tumor of the esophagus. The patient returned with a slight local recurrence a month later. The diathermic coagulation was repeated, and the patient had remained well for six months at the time the report was written. There was little or no unfavorable reaction to this form of treatment.

Newland<sup>31</sup> briefly reported the successful removal of the cervical portion of the esophagus for carcinoma. The patient died three months

28 Abbate, Luigi. Luftrohrensarkom beim Kinde. Erfolgreiche endotracheale Radiumbehandlung, Arch f Ohren-, Nasen- u Kehlkopfh **140** 179-186 (Oct) 1935

29 King, E S J. Oesophagectomy for Carcinoma of the Thoracic Esophagus. Brit J Surg **23** 521-529 (Jan) 1936

30 Moersch, H J. Carcinoma of the Esophagus Removed by Surgical Diathermy, Proc Staff Meet, Mayo Clin **10** 433-435 (July 10) 1935

31 Newland, Henry. Cervical Oesophagectomy for Carcinoma, Australian & New Zealand J Surg **5** 187-190 (Oct) 1935

late<sup>1</sup>, after a plastic reconstruction of the esophagus. No metastasis or recurrence was found.

Turner<sup>32</sup> gave a fascinating discussion of the problem of surgical removal of a malignant tumor of the esophagus. From his experience in 19 cases in which the growth was actually removed, he argued that this type of growth is not the completely hopeless problem it has been considered to be and that at present it is a surgical problem rather than one of radiotherapy. He expressed the belief that the cause of failure in those cases in which the condition presented is favorable as regards extent, mobility and lack of metastasis is lack of technical preparation and knowledge. Many interesting facts are contained in his article. He reviewed the anatomy, bringing out the fact that the esophagus is essentially free from fixation and lies as if in a tunnel of areolar tissue. This makes it possible to employ the "pull-through" method of removal of the diseased portion without great danger. Rupture of the pleura presents one of the main dangers of operation on the esophagus, mediastinitis, another. He further noted that although the esophagus is greatly distensible, it is not very extensible and that if more than 4 cm. has to be removed, as is usually the case, an end to end anastomosis is not possible without excessive tension. An artificial esophagus may be fashioned later out of skin. The portion just above the diaphragm is poorly supplied with blood, and this is another source of danger. Turner advocated thorough investigation by roentgen rays, endoscopy and palpation, and if doubt still remains as to the clinical indication for operation, an exploratory operation. It is impossible to go into detail as to the various forms of approach and technic in a short abstract, but the entire article well merits reading. The point is made that all patients complaining of dysphagia or obstruction are potential victims of cancer of the esophagus and the esophagus should be immediately investigated by all the methods at the disposal of medical scientists. Turner agreed with Jackson that cancer of the esophagus tends to be slow in development and late to metastasize.

Edwards<sup>33</sup> reported the successful removal of the entire thoracic portion of the esophagus by the transpleural route in a patient suffering from basal cell carcinoma of the lower third of the esophagus. The operation was preceded by artificial pneumothorax of the left lung. In the course of the operation the right pleura had to be opened, and positive pressure was applied to the right lung. After operation the air was aspirated from both pleural sacs, and the lungs were reexpanded without difficulty.

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32 Turner, G. G. Carcinoma of the Oesophagus. The Question of Its Treatment by Surgery, *Lancet* 1 67-72 (Jan 11) 130-134 (Jan 18) 1936.

33 Edwards, A. T. Transpleural Removal of Total Thoracic Oesophagus, *Proc Roy Soc Med* 29 188-190 (Dec) 1935.

Mathews and Schnabel<sup>34</sup> reviewed 108 necropsies in cases of carcinoma of the esophagus. The salient point of their report was the discovery that 20.3 per cent of the lesions were nonstenosing and had caused no symptoms referable to the esophagus. Further interesting facts were the comparatively brief survival of patients with this type of involvement and the apparent lack of relationship between the activity of the growths as measured by the Bionders' classification, the clinical course and the tendency to stenosis. Mathews and Schnabel concluded that in cases in which there are loss of weight, pain in the chest, vomiting and hoarseness but roentgenologic findings are negative, esophagoscopy should be employed.

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34 Mathews, R. W., and Schnabel, T. G. Primary Esophageal Carcinoma, with Especial Reference to a Nonstenosing Variety. A Clinicopathologic Study Based on One Hundred and Eight Necropsies, *J. A. M. A.* **105** 1591-1595 (Nov 16) 1935.



## News and Comment

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### ADVISORY BOARD FOR MEDICAL SPECIALTIES

The annual meeting of the Advisory Board for Medical Specialties, which is the coordinating board of the twelve certifying boards in the various special fields, the Association of Medical Colleges, the American Hospital Association, the Federation of State Medical Boards of the United States and the National Board of Medical Examiners, was held at Atlantic City, N J, on June 6, 1937

The following officers were elected president, Willard C Rappleye, M D, New York, vice president, W P Wherry, M D, Omaha, secretary-treasurer, Paul Titus, M D, Pittsburgh, executive committee, W B Lancaster, M D, Boston, and R C Buerki, M D, Madison, Wis

Dr Louis B Wilson, of Rochester, Minn, the retiring president of the board, was elected an emeritus member

### THE AMERICAN BOARD OF OTOLARYNGOLOGY

An examination was held in Philadelphia on June 7 and 8, 1937, prior to the meeting of the American Medical Association. Ninety-four candidates were examined, of this number, seventy-two were certified

An examination will be held in Chicago on Oct 8 and 9, 1937, before the meeting of the American Academy of Ophthalmology and Otolaryngology. Prospective applicants for certification should secure application blanks from the secretary, Dr W P Wherry, 1500 Medical Arts Building, Omaha

# Abstracts from Current Literature

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## Ear

PHYSICAL IMPAIRMENTS OF DEAF CHILDREN G L DRENNAN, Illinois M J  
70: 254 (Sept) 1936

In a survey of fifty-eight children entering the Illinois School for the Deaf in 1936, Drennan and his associates found that 56.9 per cent came to that institution as a result of acquired deafness, and 39.6 per cent were congenitally deaf. A congenitally deaf child, they found, may be the victim either of frankly hereditary forces or of an obscure lesion. Owing to the constant intermarriage between deaf-mutes and the fact that speaking and hearing members of such families often have deaf-mute children, congenital deaf-mutes have been increasing in number.

Drennan believes that it cannot be emphasized too strongly that most deafness is partial and acquired. Deafness of all types is more easily prevented than cured, and the efforts toward prevention of deafness cover the entire field of biologic activity.

Meningitis was the etiologic factor in 27.2 per cent, whooping cough, in 18 per cent. All those deaf as a result of whooping cough were deafened before they were 1½ years of age. Measles was the cause in 11.8 per cent of the cases, scarlet fever, in 6 per cent. Following these, there were causes such as congenital syphilis, undiagnosed fever, mastoiditis, otitis media, fracture of the skull, injury to the head, typhoid and summer complaint (cholera morbus). Of the group studied 73 per cent became deaf before the age of 5 and 64 per cent before the age of 2. Among those under 2 years of age, whooping cough and meningitis were each the cause in 28.5 per cent, and measles in 9.5 per cent. The control of infectious diseases and skilled attention to the ears when complications are present will do much to diminish the frequency of deafness from these causes.

This group of fifty-eight children studied from the point of view of general physical defects exclusive of deafness presented an interesting challenge, that is, 90 per cent of the group showed one or more physical defects besides that for which they were admitted to the school, 80 per cent showed defects which necessitated medical attention. Of the group who were deafened by 2 years of age, 100 per cent showed other physical defects. The need to prevent these physical defects antedates the school age by five and a half or six years. Proper care in infancy and immunization against diseases for which active immunizing agents are available will accomplish much toward perfecting the development of children. Early diagnosis of the infectious diseases and prompt administration of indicated antitoxins, vaccines or antiserums are important in preventing the dire complications, which are frequently more serious than the disease itself.

BARBOUR, Peoria Ill [AM J DIS CHILD]

NERVES OF THE DURA MATER OF THE POSTERIOR CRANIAL FOSSA AND THEIR IMPORTANCE IN THE DIAGNOSIS AND SURGICAL TREATMENT OF PETROSITIS  
C F PORTA, Arch ital di otol 48:289 (May) 1936

Porta made an anatomic study of the innervation of the dura mater of the posterior cranial fossa and found that it is constituted by the trigeminal nerve through the ophthalmic nerve and by the vagus through the posterior branch of the meningeal nerve from the jugular ganglion. Because of the relations of these nerves with those of the dura of the petrous bone and of the special innervation of the latter, the author states that the retro-orbital and occipital pain that are constant in petrositis originate, respectively, in the ophthalmic branch of the gasserian ganglion and in either Arnold's nerve (a branch of the ophthalmic nerve) or the branch of the meningeal nerve of the vagus. The type of pain—retro-orbital or

occipital—is of diagnostic value for the presence of petrositis, for determination of the location of the petrositic process and, in this connection, for the selection of the petrositic cells, either anterior or posterior, which should be opened at the operation

EDITOR'S ABSTRACT

CLASSIFICATION OF INFLAMMATIONS OF THE PETROUS PYRAMID A TOBECK, Arch f Ohren-, Nasen- u Kehlkopfh 141 61, 1936

In this report Tobeck aims to bring order into the confusing and partly misleading terminology of the otogenic, inflammatory, extralabyrinthine processes of the petrous pyramid. He bases his classification of these disorders on the anatomic and structural conditions of the pneumatized or non-pneumatized petrous pyramid. He further emphasizes the importance of the correct evaluation of the inflammatory histopathologic changes in applying terms to the various subgroups of inflammation of the pyramid.

In giving attention to these factors he was able to devise a classification which does justice to all clinical as well as pathologic-histologic requirements. For the main group, which includes all subgroups, he recommends the term otogenic extralabyrinthine pyramidal inflammation. He also differentiates two subgroups: (1) the suppuration of the pyramidal cells with its various subtypes and (2) osteomyelitis of the pyramid.

EDITOR'S ABSTRACT

POSITIONAL VERTIGO AND VERTIGO-PRODUCING POSITION, POSITIONAL NYSTAGMUS AND NYSTAGMUS-PRODUCING POSITION E RUTTIN, Monatschr f Ohrenh 70 257 (March), 455 (April), 523 (May) 1936

Ruttin defines as positional vertigo the vertigo that develops when the head or the head and body change position and as vertigo position that position which produces vertigo. In the same manner he defines positional nystagmus and nystagmus position. In this paper he reports and discusses a number of carefully observed cases that throw some light on this phenomenon. He disregards the various labyrinthine disorders in which every shifting of the head or of the head and body elicits vertigo and nystagmus, having discussed them in a previous report. Under the heading of positional vertigo and positional nystagmus he wishes to take up only those cases in which one or several definite positions result in vertigo and nystagmus. He assumes that a pathologic process of the vestibular apparatus (in the restricted sense), that is, of the utriculosaccular apparatus or its central portions, is the causal factor in these cases. To be sure, there are cases in which the utriculosaccular apparatus as well as the semicircular canals are involved. Among the types of nystagmus that are elicited by disturbance of the semicircular canals, the horizontal and rotatory types are generally accompanied by a shifting of the vertical meridian, and the vertical type, by a shifting of the equator of the cornea. For horizontal and vertical nystagmus this is readily understandable, since there is no inclination of the meridian but only a shifting. However, in rotatory nystagmus there are shifting and inclination of the meridian. It must be noted that the nystagmus which frequently develops in the cases of pure positional nystagmus shows pure rotation, that is, only inclination of the meridian, without shifting, or pure wheel turning. The author designates this latter type of nystagmus as "wheel-turning nystagmus" and emphasizes that there are not three but four basic forms of nystagmus: horizontal, vertical, rotatory and wheel turning. His observations indicate that this wheel-turning nystagmus is characteristic for pathologic changes in the utriculosaccular apparatus, whereas the horizontal, rotatory and vertical types of nystagmus indicate involvement of the semicircular canals.

After an analysis of several groups of cases the author concludes that the diseased as well as the healthy side may be in the nystagmus position and the nystagmus position may elicit homolateral and contralateral nystagmus, irrespective

of whether it is the diseased or the healthy side. Thus, the cases demonstrate that neither the nystagmus-producing position nor the direction of the positional nystagmus permits a conclusion as to the side of the lesion. This impossibility to deduce the side of the localization of the pathologic process from the nystagmus position or from the direction of the positional nystagmus applies even to cases of cerebral tumor.

EDITOR'S ABSTRACT

CLINICAL ASPECTS OF CONCUSSION OF THE EAR BY A STROKE OF LIGHTNING  
GLADKOFF, *Monatschr f Ohrenh* 70 289 (March) 1936

Gladkoff reports observations on several patients who sustained injuries from lightning. One patient, who had been at the telephone when lightning struck, had the sensation of falling from a great height. He sustained second and third degree burns on the left shoulder, in the axilla, on the abdomen, on the scrotum and on the leg. The author reports the results of examination of the cochlear and the vestibular apparatus. The cochlear function was reduced. The examination of the vestibular apparatus disclosed no spontaneous nystagmus, and changes in the position of the head produced no pathologic reflexes, although the anamnesis revealed severe labyrinthine reactions (feeling of a fall from a great height and cerebral vertigo).

The author further describes the results of examination of four other patients. The patients complained of a greater or lesser impairment of hearing, particularly immediately after the lightning had struck, and of noises in the ears. One patient had petechial hemorrhages in the tympanic membrane and hyperemia of the auditory meatus. In another patient a blood clot was found in the center of a dry perforation. The region behind the ear was burned in this patient. In two other patients, in whom the lightning had left no visible traces on the head, the author observed reduction of the air conduction for low as well as high sounds. The impairment of hearing was greater on the side on which the lightning had struck. The bone conduction was reduced in all cases. The Weber reaction was lateralized in the direction opposite to the side on which the lightning struck.

EDITOR'S ABSTRACT

SURGICAL CURETTMENT OF THE PETROUS PYRAMID S. UNTERBERGER, *Ztschr f Hals-, Nasen- u Ohrenh* 39 381, 1936

Unterberger says that in case of suppuration of the petrous apex in the course of acute or chronic otitis media with or without Gradenigo's syndrome, the customary surgical methods are often inadequate to insure drainage of the pus and to prevent or cure meningitis. He describes a new method for the opening and curetting of the suppurating pyramidal apex by way of the internal ear, not from the posterior cranial fossa but rather from the middle fossa and not, as formerly, through the entire internal ear but through only the attic of the internal ear above the facial nerve and the internal auditory meatus, which in its attic portion near the fundus is opened in this intervention.

The author maintains that this is the shortest way to the pyramidal apex, it being much shorter than the way through the internal ear from the posterior cranial fossa. Another advantage is that it is much less dangerous. There is no interference with the sigmoid sinus and with the bulb of the jugular vein, as is the case in the method in which the approach is by way of the posterior cranial fossa. Moreover, the internal auditory meatus is not opened in such a manner that it is entirely obliterated so that portions of the brain will push forward and cause obstruction. The facial nerve is better protected than in the other method. The removal of the interfering portions of the labyrinth is considerably facilitated, for chiseling on a precipitous and extremely hard bone surface with the added danger of possible injury to the dura mater which is necessary in case of approach from the posterior fossa is avoided in the author's method. During the

entire intervention the petrosa itself remains tightly connected with the tabular part of the occipital bone and with the other parts of the temporal bone. Thus, there is no danger that it may break off and make difficult or impossible the further penetration of the apex. Moreover, the method provides a better survey and more effective drainage than do other procedures.

EDITOR'S ABSTRACT

MILIARY TUBERCULOSIS AND OTITIS MEDIA E. ZIEGLER, *Ztschr f Hals-, Nasen- u Ohrenh* 39 391, 1936

Ziegler points out that the literature contains reports of numerous cases in which miliary tuberculosis with simultaneously existing suppuration of the middle ear was regarded as otogenous sinus thrombosis or a cerebral abscess or caused other diagnostic difficulties. He thinks that his report of a series of ten cases, all of which were observed at the same clinic, permits a better estimate of the symptomatology and the differential diagnosis than does the study of single cases. A survey of the reported cases reveals the difficulty of recognizing at all or early enough the miliary tuberculosis that occurs with otitis media, for in only three of eight cases was the miliary tuberculosis suspected or detected while the patient was still alive. The author analyzes once more the various symptoms in order to throw light on the points that are important for early recognition. He takes up miliary dissemination, productive, caseous and cirrhotic tuberculosis, the general manifestations and the indications for surgical intervention. He says that suspicion of miliary tuberculosis should not cause the postponement of a necessary operation. In the conclusion he expresses the hope that his report has sharpened the perception for recognition of miliary tuberculosis in cases of a simultaneously existing otitic disorder.

EDITOR'S ABSTRACT

A METHOD OF TESTING ONE EAR H. MEISSNER, *Ztschr f Hals-, Nasen- u Ohrenh* 39 415, 1936

Meissner points out that it is often necessary to test the hearing capacity of one ear, particularly of one with impaired hearing. In this case it is important but difficult to exclude the hearing of the normal ear. He mentions and evaluates the methods that have been tried to accomplish this and states that at his clinic an electrical noise apparatus has been developed by Langenbeck.

With this apparatus the author made tests similar to those which Bunch reported having made with an American electrical noise apparatus. His experiments were made on normal persons and on persons with deafness of one ear. He found that whenever it is essential to deafen one ear completely in order to determine the deafness of the other, it is advisable to use an electrical noise apparatus, for these deafen completely and do not produce artificial deafness in the other ear. This is of practical importance in deciding the advisability of a labyrinthine operation and in the diagnosis of tumor of the brain. With the electrical noise apparatus of Langenbeck the author succeeded in completely excluding the hearing of one ear, without greatly impairing that of the other ear. Thus, he was able to corroborate the results obtained by Bunch, but he admits that a correct technic is important. In experiments on persons with unilateral deafness, it was determined that even if a headphone is used which is well sealed against the air and well isolated against bone conduction, a measurable portion of sound reaches the other ear and that the hearing capacity of an impaired ear cannot be exactly determined if it is approximately 60 decibels less than that of the other ear. In such cases, an electrical noise apparatus must be used. Tests on persons with unilateral conduction deafness or deafness of the internal ear should be made with both methods. The author thinks that in this manner simulation of unilateral deafness can be determined.

EDITOR'S ABSTRACT

## Pharynx

CONTROL OF TONSIL AND ADENOID BLEEDING LOUIS M PEARLMAN, M Rec  
143 194 (March 4) 1936

In the removal of tonsils and adenoids the surgeon meets with factors peculiar to bleeding from tonsils and adenoids 1 It is difficult to see and to grasp the bleeding vessels because they are hidden by the soft palate and the anterior pillars and by the tongue 2 The teeth constitute another barrier 3 Blood may be swallowed for some time and remain unobserved until it is vomited 4 The parts operated on cannot be placed entirely at rest 5 The parts cannot be aseptically dressed 6 A clot formed in the tonsillar fossa is prone to stimulate further bleeding by stretching the tonsillar fossa A history of bleeding should make the physician take all the usual preventive measures before operation Treatment should be instituted at once directly to the bleeding parts Pearlman recommends and discusses the following agents for stopping the bleeding (1) a lamb's wool tampon, (2) artery clamps, (3) chemical cautery, (4) posture and (5) astringent drinks

Reports on six cases conclude the article

WILLIAMSON, New Orleans [AM J DIS CHILD]

TRANSITORY BACTEREMIA FOLLOWING TONSILLECTOMY FISCHER and GOTTDENKER,  
Wien klin Wchnschr 49 177 (Feb 7) 1936

Among the explanations which Fischer and Gottdenker offer for the recrudescence of an old process, such as nephritis, polyarthritis or endocarditis, or the causation of a new disease, such as septicemia, following a tonsillectomy are transmission of bacteria from the wound to the blood stream, resorption of exotoxins or endotoxins from the surface of the wound and an allergic reaction in which bacterial proteins are resorbed by the wound and act as allergens The object of the investigation was to determine whether the first of these conditions, namely, the entrance of bacteria into the blood stream, is possible after tonsillectomy

The authors made investigations of the blood (obtained from the cubital vein) five minutes before and five minutes after tonsillectomy and also two, twelve and twenty-four hours later Among fifty-one patients thus investigated, sixteen showed the presence of bacteria in the blood stream after tonsillectomy The maximum bacteremia was observed two hours after the operation From twelve to twenty-four hours after operation the blood was always sterile In the sixteen cases in which organisms were present the following bacteria were found anhemolytic streptococci, seven times, pneumococci, once, Staphylococcus aureus-haemolyticus, three times, Staphylococcus albus, twice, and Staphylococcus aureus-anhaemolyticus, three times A relation between the bacteria cultivated directly from the tonsils and those from the blood could not be proved The indications for tonsillectomy were recurrent sore throat with or without general symptoms (polyarthritis or endocarditis) The operation was usually undertaken some time after the angina had subsided and only once immediately after an attack For control, the blood of fifteen patients who underwent other operations, such as resection of the septum, was observed In one case Staph aureus-anhaemolyticus was found, in the remaining cases blood cultures were sterile

Schwarz and Frisch noted bacteremia in three of eleven patients immediately after tonsillectomy Two hours after tonsillectomy Bartlett and Pratt found streptococci in 6 per cent of the cases Wirth could find no evidence of bacteremia after tonsillectomy in forty-five patients

ABT, Chicago [AM J DIS CHILD]

DIFFICULTIES OF HISTOLOGIC DIAGNOSIS OF MALIGNANT PROCESSES OF THE EPI-PHARYNX K WOLFF, Ztschr f Hals-, Nasen- u Ohrenh 39 344, 1936

Wolff directs attention to the great service rendered by Gräff in showing that in malignant tumor with obscure origin the primary focus may be in a locality

which hitherto has received little attention in the postmortem examinations, namely, the nasopharynx and its accessory cavities. Graff's merit is especially great, because he also devised a method that permits exposure of the nasopharynx, which gives a good survey over the region.

The author describes two malignant processes of the epipharynx, in which the new technic of Graff was employed. The cases are especially noteworthy because of the peculiar manner in which the processes spread and particularly because they show the histologic-diagnostic difficulties that are encountered in the examination of a single section. In the first case, the postmortem examination confirmed the existence of a tumor of the epipharynx. The lymph nodes of the neck had nearly all become transformed into tumor-like nodules. The lymph nodes of the pulmonary hilus were likewise enlarged. However, the case history contains nothing regarding hyperplasia of the lymphatic tissues of the intestine. The most surprising aspect was presented by the stomach, for tumor nodules were found in all portions of its mucous membrane. The tumor in the epipharynx gave at once the impression of a malignant growth.

After giving a detailed description of the histologic aspects, the author says that on account of the various cell forms it might be justifiable to think of "the peculiar tumors suggesting granulomas," which Krauspe had observed in the upper air passages and in the digestive tract. Krauspe suggested the term sarcomatous reticuloendotheliosis. Wolff says that in the reported case a sarcoma existed, which originated in the reticulum. After demonstrating that the process was neither lymphogranulomatosis nor lymphosarcoma, he concludes that the growth was a reticulosarcoma. In the second case the aspects of chronic inflammation predominated. However, a cervical lymph node revealed signs of malignant growth. In the conclusion Wolff emphasizes once more that in case of a tumor in the region of the neck, in which the origin is obscure, the region of the nasopharynx should always be carefully examined.

EDITOR'S ABSTRACT

## Nose

SINUSITIS IN CHILDREN. LAWRENCE K. GUNDRUM, *Arch. Pediat.* **53**: 287 (May) 1936

The subject of sinusitis is reviewed by Gundrum. The type most frequently seen in children is a low grade catarrhal sinusitis. The treatment which the author has found most successful is the displacement irrigation suggested by Proetz. The medicament used is either 0.5 per cent ephedrine in a physiologic solution of sodium chloride or 0.5 per cent phenol in light liquid petrolatum. The author states that recently he has had favorable results with diluted bacterial antigens. Slightly better results were obtained by the use of stock rather than autogenous antigens.

The treatment consists of a 10 per cent solution of bacterial antigen in a 0.125 per cent solution of neosynephrin in a physiologic solution of sodium chloride. The concentration of the antigen is gradually increased until a maximum of a 50 per cent to 100 per cent solution is reached. The stock antigen consists of staphylococci, streptococci and *Bacillus coli*.

Three case reports are included in the paper.

ORR, Buffalo [*Am. J. Dis. Child.*]

INDICATIONS FOR SURGICAL TREATMENT OF SUPPURATIONS OF THE MAXILLARY SINUS. F. IPOLYI, *Monatschr. f. Ohrenh.* **70**: 401 (April) 1936

Ipolyi thinks that a puncture of the sinus should be made in every case in which the presence of suppuration has been determined or in which the subjective or objective symptoms, the diaphanoscopy or the roentgenogram indicate the presence of such a process. A puncture giving a positive result should always be followed by irrigation. New suppuration usually yields to this treatment.

However, if the symptoms of perforation become noticeable or the tension is too severe on account of an excessive amount of pus, a wide endonasal opening is advisable. Thus, the evacuation of the secretion is facilitated and can eventually be accelerated by daily irrigation. A radical operation is rarely necessary in acute cases, only if the severe symptoms do not disappear after the wide opening and if necrosis or perforation must be suspected, is such an intervention justified. Systematic irrigation counteracts even a considerable percentage of the chronic suppurations. At the author's clinic, irrigations are usually tried for from five to six weeks. If this treatment does not effect cure, a more extensive intervention is resorted to, such as a wide opening. A radical operation is necessary only if irreparable changes have taken place in the mucous membrane. The Luc-Caldwell method is the radical operation that is most often resorted to at the author's clinic, because it gives a good survey, causes the least dental complications and does not cause disfigurement. Denker's operation is performed at his clinic if interventions on the ethmoid and the sphenoid sinus are required simultaneously and in case of tumor. Of 1,413 patients with empyema of the maxillary sinus, who came up for treatment at the clinic in the course of eleven years, the condition of 921 responded to irrigation, in 320 it was cured by the wide endonasal opening made according to the Lathrop-Claoue method, and in 167 it required radical operation (the Luc-Caldwell, Denker or Sturmann procedure).

EDITOR'S ABSTRACT

CONGENITAL EPITHELIAL DUCTS AND CYSTS OF THE BACK OF THE NOSE C. E. BENJAMINS, *Nederl tijdschr v geneesk* **80** 1886 (May 2) 1936

Benjamins delivered a clinical lecture on some observed cases of congenital cysts and ducts of the back of the nose, which never communicate with the cavity of the nose and which show an exclusively dermoid character. Especially toward puberty further development is possible. The source of the deviations is extensively discussed. The treatment should always be surgical.

VAN CREVELD, Amsterdam, Netherlands [AM J DIS CHILD]

### Miscellaneous

PATHOLOGIC HISTOLOGY OF THE CRICO-ARYTENOID JOINT L. HORBST, *Monatschr. f Ohrenh* **70** 48 (Jan) 1936

Horbst points out that the literature contains several reports on inflammatory changes of the crico-arytenoid joint in rheumatism, typhoid, gout, gonorrhea and other conditions. However, since there is as yet no record of systematic examination of this joint and its histologic changes under various conditions, it is the author's aim to supply information about this problem. In the course of examination of thirty-four crico-arytenoid joints, he observed changes of the capsule as well as of the cartilaginous and the bony portions of the joint. The incidence of the interruptions in continuity and the formation of large synovial villi that are frequently rolled up or in balls in the variformed bays of the capsule indicate that their development is related to the articular movements that take place under physiologic conditions. Occasionally, detached villi are pushed into the articular space, and here they undergo hyalinization and calcification. The pathogenesis of the changes of the cartilaginous covering of the joint are explained with consideration of the function of the joint. The cartilaginous covering nearly always shows loosening and fraying in its surface layer as well as areas of wearing down and formation of villi. The superficial fraying out and wearing down either of the socket or of the head of the joint cause roughness of the surface and further wearing down may result in disappearance of the cartilaginous covering. In addition to these changes resulting from mechanical wear on the articular surfaces, Horbst in two cases observed at the osteocartilaginous margin small foci of traumatic destruction, which were filled with granular detritus. In three cases



he detected that as a result of these mechanical and traumatic impairments of the articular cartilage, medullary spaces and vascular formations had penetrated through the zone of calcification of the articular cartilage into the uncalcified cartilage. In this connection Horbst calls attention to studies by Pommer and Lang, which revealed that such processes of vascularization and ossification of the articular cartilage characterize the beginning stage of arthritis deformans.

EDITOR'S ABSTRACT

SUPPURATION OF THE MIDDLE EAR, ACCESSORY NASAL SINUSES AND PHARYNX IN PATIENTS WITH DIABETES. B. KECHT and H. DIBOLD, *Ztschr f Hals-, Nasen u Ohrenh* 39 288, 1936

Kecht and Dibold point out that in operations on the ear, nose and throat, as in all surgical interventions, the existence of diabetes mellitus involves special indications and contraindications. After mentioning the indications and contraindications, the authors discuss the preparation of the diabetic patient for surgical treatment and then describe their own observations on seventeen cases of suppuration of the middle ear and on three cases each of suppuration of the accessory nasal sinuses and of peritonsillar suppuration. On the basis of these observations they conclude that the course of acute otitis media is different in diabetic patients in that it leads to mastoiditis more often than in nondiabetic patients.

The mastoiditis of diabetic patients as a rule shows no peculiarities, a deficiency of symptoms could not be observed. The mortality for mastoiditis was higher in the diabetic patients when it was compared with the mortality of nondiabetic patients of all age groups (23.5 per cent compared to 10.9 per cent), however, it is approximately the same if only the older patients are taken into consideration. In young persons, the prognosis is on the whole rather favorable, even if the diabetes is severe. However, in older persons (beyond the age of 55) with other disorders, such as tuberculosis, vascular disease, anemia or cachexia, the prognosis is unfavorable. In this latter group of patients it is therefore advisable to operate early, whereas in younger persons an expectant attitude is permissible. Suppuration of the accessory nasal sinuses and peritonsillar suppuration have no unusual aspects in diabetic patients. From the intermistic point of view, the authors emphasize that the existing suppuration exacerbates the metabolic disorder and that there is improvement as soon as the focus of suppuration is removed. For this reason a surgical intervention is more urgent for diabetic than for nondiabetic patients.

EDITOR'S ABSTRACT

# Society Transactions

## CHICAGO LARYNGOLOGICAL AND OTOLOGICAL SOCIETY

*Regular Monthly Meeting, April 5, 1937*

IRA FRANK, M D, *President*

WALTER H THEOBALD, M D, *Secretary*

### PROGRAM PRESENTED BY UNIVERSITY OF ILLINOIS COLLEGE OF MEDICINE

SWELLINGS OF THE NECK DR R B MALCOLM (by invitation)

The following cases were observed

Tumors and cysts	250	Location of tumors and cysts	
Tuberculous adenitis	100	Submaxillary triangle	72
	—	Carotid triangle	163
Total	350	Muscular triangle	15
Origin Epiblastic		Origin Mesoblastic	
Cysts	46	Cysts	2
Tumors	127	Tumors	25
Benign	28	Benign	12
Malignant	99	Malignant	13
		Hodgkin's disease	40
		Leukemia	10

*Submaxillary Triangle*—The lesions in the parotid gland included the following benign tumors, 23—mixed tumors, 22, papillary cystadenoma, 1, malignant tumors, 15—adenocarcinomas, 12, squamous cell tumors (papillary), 2, cystadenocarcinoma, 1

The results in benign tumors were excellent, although there were some instances of recurrence requiring a second operation. The results in malignant tumors were disappointing. Four adenocarcinomas developed in previously existing mixed tumors.

The lesions of the submaxillary salivary gland included 3 cysts, 4 mixed tumors and 1 adenocarcinoma.

Two cysts of the sublingual salivary gland were observed.

There were 30 resections of the submaxillary triangle for carcinoma of the lip, 6 for metastatic carcinoma and 2 for malignant melanoma.

Cyst of the thyroglossal duct was observed 20 times. The result in 19 lesions was excellent, 1 required a second operation. Cystic hygroma was observed once.

*Carotid Triangle*—Branchial cyst was observed in 19 cases. The results in all these were excellent. In every case the cyst arose from the second cleft. In every case it was deep to the posterior belly of the digastric muscle and superficial to the stylopharyngeal muscle and lay between the external and the internal carotid artery.

Branchiogenic carcinoma was observed in 4 cases. In 3 resection was performed and the jugular vein was taken away. Two patients died within a week after the operation, the third lived eighteen months. In the fourth case the growth involved the vein and the carotid arteries in a woman aged 70, so no attempt was made to remove it.

Tumor of the carotid body was observed in 2 cases. In the first case the growth was a malignant tumor, and attempt at removal was unsuccessful. The patient died some months later. The diagnosis was ganglioneuroblastoma. In the second case a woman aged 37 had a small mass in the region of the bifurcation of the carotid artery. The mass was thought to be a lymph node, but on exposure the color made the diagnosis. It was successfully removed, the adjacent sheath of both carotid arteries being taken with the tumor. The blood pressure at the commencement of the operation was 120 systolic and 80 diastolic, and on traction on the tumor it fell to 70 systolic and 50 diastolic. When the tumor and the nerve attached to it were removed, the pressure went up to 100 systolic and 75 diastolic. After the operation the pressure went up to 180 systolic and 80 diastolic. It persisted at that level for several months and gradually came down to normal. Microscopic examination showed an adenoma of the carotid body, measuring 6 by 4 by 3 cm.

Metastatic carcinoma was observed 73 times. The tumors were secondary to carcinoma in the tonsil, pharynx, tongue, lip, larynx, esophagus, thyroid gland, stomach and even the lung, adrenal glands and other areas, which could not be differentiated. Of particular interest were 4 metastatic hypernephromas and 4 neurocytomas.

Lymphosarcoma was observed in 8 cases, in 5 the growth was of the lymphocytic type and in 3 of the reticulum cell type. This group was of particular interest on account of the variation in size and the softness to the touch. Clinically, this condition resembles Hodgkin's disease.

Other tumors of mesoblastic origin included fibrosarcoma, 2, lipoma, 9. These were all subfascial and were of the dissecting type, so that when they were completely removed practically the whole neck was exposed.

Lymphangioma was observed in a child aged 10 years. On removal, the growth was found to arise from the radicles of the right lymphatic duct. Neuroma was observed in 1 case and neurofibromatosis in 1.

Hodgkin's disease was observed 40 times. This series gave the greatest variation in the histologic changes. In some cases it was difficult to differentiate them from those in lymphosarcoma.

Leukemia was observed in 10 cases. The only operation was removal of tissue for biopsy except in 1 case, in which I did a total thyroidectomy as an experiment to reduce the basal metabolic rate, hoping to improve the condition. The patient died in six weeks.

*Muscular Triangle.* All the 15 cases of swelling in the muscular triangle were instances of carcinoma of the thyroid gland. The results following thyroidectomy and in some cases removal of the adjacent involved lymph nodes were disappointing. One interesting case was observed in a girl aged 11 years.

All these cases are from the records of the Research and Educational Hospital of the University of Illinois College of Medicine or from my private practice.

#### ROENTGEN RAY STUDIES OF THE SOFT TISSUES OF THE NECK. DR. PAUL H. HOLINGER (by invitation)

The soft tissues of the neck lend themselves readily to roentgen study. This is due to the variation in density of the gross structures. The trachea, entirely hollow and containing air, serves as a perfect background against which the soft structures and the laryngeal cartilages may be silhouetted.

Such studies, both anatomic and pathologic, have been carried on since shortly after Roentgen's discovery, of note are the works of Sheier, Thost, Iglauer, Hay, Mosher and the Jacksons.

The value of roentgen studies of the soft tissues of the neck is dependent on cooperation between the roentgenologist and the laryngologist. The final evaluation of the pathologic condition must be made by comparison of the direct observations and the roentgenograms, one study supporting the other.

For infants and children, as well as in adults for whom indirect examination of the hypopharynx and larynx is impossible, the roentgenogram is indispensable in making a preoperative diagnosis. This makes a blind approach unnecessary.

Special roentgen studies must be made of the soft tissues of the neck in cases of dyspnea, hoarseness and dysphagia. These studies are indispensable in cases of foreign body, pharyngeal, laryngeal or tracheal tumor and esophageal obstruction. They are of special value in the fitting of tracheotomy tubes. The extent and clinical course of a lesion, benign or malignant, may frequently be determined more accurately on the roentgenogram than by direct examination. In no instance, however, can the film be substituted for direct examination and biopsy.

#### DISCUSSION

DR FRANCIS L. LIDLIR. The time allowed is not adequate for speakers of such wide experience to present all this material and do justice to it, nevertheless, they have covered a great deal of ground.

Dr Malcolm's experience with 350 cases certainly accounts for his enthusiasm, especially due to his profound respect for and knowledge of anatomy and pathology. So far as laryngologists are concerned, difficulty arises in confusing swellings of the neck, particularly in the early stages, with lymphadenitis of pharyngeal origin. When this particular type of lymphadenitis fails to respond to therapy, they begin to think of abscess, and when leukocytosis is absent together with fever, fluctuation or tenderness, they often suspect tuberculous adenitis affecting the cervical glands, especially if the process involves both sides.

The branchial cysts are interesting. If one were confronted with a history that the mass had been present for a long time and had failed to increase in size, one might suspect the presence of a cyst.

The lymphoblastomas for which Dr Malcolm presented the histopathologic observations are interesting. Hodgkin's disease was illustrated with a particularly excellent slide. I think material aid is being given by the roentgen rays alone in those cases, possibly with the therapeutic test if the lesion responds to roentgen therapy.

Bronchiogenic carcinoma or tumor arising from bronchial remnants occasionally confronts one. A branchioma increases rapidly in size. Usually such a growth is located in the upper anterior cervical triangle. The patient consults the physician with hoarseness, otalgia and pressure symptoms. Metastatic tumors of thyroid, laryngeal, pharyngeal and sinus origin as well as those due to leukemia occasionally present themselves.

The mixed tumor Dr Malcolm showed on the lantern slides presented three different types of tumorous pathologic changes, with malignant degeneration in one section. This interesting case history dated back to 1912, the patient having had eleven resections before I referred her to Dr Malcolm. I am indeed sorry that Dr Malcolm did not have more time to cover fully the details of such interesting cases.

Dr Holinger's paper illustrates the value of the roentgenogram of the neck as a definite corroborative, diagnostic and prognostic aid. He has presented an excellent selection of material which emphasizes the importance of the close study of the films, which add much to information concerning the structures in this region. The short time allowed the essayist did not permit his covering every type of tumor or pathologic change that might be visualized in this region. The neoplasm and destruction due to tuberculosis and syphilis and the like can also be visualized in the roentgenogram. Dr Malcolm and Dr Holinger presented something well worth while.

DR WAITER H. THORALD. I had a somewhat selfish motive in asking Dr Malcolm to discuss swellings of the neck, for I have been confronted with cases which were troublesome in diagnosis and I thought that some of the rest of the members might be having the same difficulty.

A patient who had a swelling of the neck was recently referred to me from Berlin, and I was impressed with the fact that no laryngeal examination had been made when she was in the United States two years before. At that time her tonsils were removed because of the cervical swelling. Subsequent examination

in her native country disclosed the presence of a sarcoma at the base of the tongue After vigorous roentgen therapy the swelling and the lesion disappeared

I wish Dr Malcolm in closing would tell something about the treatment of inflammatory swellings of the neck by roentgen therapy

DR ROBERT B MALCOLM I believe that every patient with tuberculosis of the neck in which there is no fluctuation should be treated with roentgen rays That gives excellent results If there is fluctuation, an incision should be made, the pus evacuated and the wound sewed tight and treated with roentgen rays For other inflammatory swellings I think Hilton's is the method of choice

I feel that all tuberculosis reacts well to roentgen rays Some of the sarcomas melt away after treatment with radium and roentgen therapy, but, unfortunately, they return with increased vigor and the terminal result is well known In the treatment of lymphosarcoma roentgen therapy is hopeless

#### ABSCESS OF THE BRAIN DR ERIC OLDBERG (by invitation)

Abscesses present a multiplicity of problems, and each abscess is a problem in itself in that its position, the type of organism which infects it, its age, the amount of walling off present, the amount of edematous brain surrounding it and the seriousness of the damage which its presence produces are all factors which influence judgment as to treatment

This paper outlines the radical and conservative methods of treatment in general use I favor conservative treatment for most abscesses, with repeated tapping and eventual extirpation, if necessary Statistics are given as to favored sites for abscess, and experiences with the several varieties are detailed

#### DISCUSSION

DR PERCIVAL BAILEY (by invitation) I used to think I knew something about the treatment of intracranial infection, but as I grow older—and I am not so very old—I find that every time I do something I wish I had done something else For me the anxious period is not that in which there is an abscess fairly well developed but that in which the otologist has done a mastoidectomy and the patient has a drop in temperature and begins to feel better and then shows symptoms again That is the anxious period not only for the otologist but for the neurosurgeon What is going on? Is the patient getting a reinfection of the mastoid, is he getting an infection of the sinus that will go on into meningitis, or what? It is an anxious period for every one concerned with the case, and it is the period in which the patient is most difficult to treat, for what the physician is to do depends on the diagnosis, and a diagnosis has to be made quickly He has to make up his mind what he will do or whether he will do anything If the patient goes on for a week or two and does not die, the physician usually has plenty of time to make up his mind what he will do and what the condition is

Suppose that the patient has an abscess and has gone on for a week after his second rise in temperature and that he obviously has no meningitis, for spinal punctures have been made and have revealed only a few cells, he is not showing a daily high temperature and there are no bacteria in the blood stream He probably has no mastoiditis, so there is no reason to operate again, but he is very sick, vomits and perhaps has some headache and some swelling of the optic disks The physician then begins to think that there is some infection which has passed through the meninges and into the brain Then what is he to do? From some bitter experiences I have come to feel, as Dr Oldberg does, that the less one does the better If necessary, one may make a small opening and attempt to aspirate the abscess That should be done only if the patient has choking of the optic disks and increased intracranial pressure, so that he cannot go on without something being done By tarrying one runs the risk of infection passing into the ventricles, so that the patient has ventriculitis and secondary meningitis, but I think the risk is less than that from interfering with the abscess at that stage If one simply takes a needle and punctures the abscess and aspirates repeatedly, as often as is necessary, sometimes the abscess will heal At any rate, it will

sterilize itself and build a thick wall, and one will not have to operate on it immediately. Dandy's statements lead one to believe that healing will always happen, but I think that opinion is exaggerated.

If one punctures the abscess several times and the symptoms continue to recur, how shall one treat the abscess? Under those circumstances, as Dr Oldberg indicated, one may act in any of several ways. One may put in a drain, allowing the abscess to collapse on itself and allowing the drain to extrude itself so that the lesion will heal. In some cases, however, after the drain is extruded and the wound closes, an abscess forms beneath and has to be operated on subsequently. Another method is to open the dura widely and allow the abscess to extrude itself. That will happen, but in many instances some of the brain will extrude itself with it, and hemiplegia and other unpleasant things are likely to follow. A third method of handling such an abscess has recently been used to a great extent in Paris, particularly by Vincent and his associates. This consists of puncturing several times until the abscess forms a firm wall and then extirpating the abscess as if it were a tumor. That had happened before this treatment was introduced, but by accident.

Vincent now has a large number of cases in which he has deliberately extirpated abscesses in that way, with excellent results. I was so impressed with his work that I have done it myself and have succeeded well. I think this is an advance in surgery, but I am not willing to advocate it for every case on the basis of my own experience—1 case in which extirpation was done by accident and 1 in which it was intentional. It may happen that one attempts to do this with the ventricles, the meninges and everything wide open and is unfortunate enough to rupture the abscess. That happened to me recently. I was enthusiastic about my first success and was attempting to extirpate another abscess. So I did—I made an incision around the wall of the abscess and behind it and was just about to extirpate it when pus began to well out, then I found a fresh daughter abscess just behind the other. I thought that was the end of the patient. The meninges and the ventricles were wide open, and there was pus in the ventricles, in the meninges and all over the brain. Sulfanilamide was given by mouth, and although the organism was a hemolytic streptococcus the child got well. I took the bone flap off, opened the abscess widely, packed gauze into the cavity from which I had extirpated the abscess and let the fluid drain out, and the child got well. The recovery can be credited to sulfanilamide or not, just as one wishes.

I feel that one should puncture an abscess repeatedly until it has time to wall itself off. If one is obliged to continue puncturing it and it continues to reform, then one has a choice of two things—either to insert a rubber drain or to extirpate the abscess as they do in France. I am much impressed with the latter method and shall continue to use it until my results teach me not to do so.

Concerning the time when infection first gets into the cranial cavity, I have never been able to make up my mind. I have been horrified at what otologists do but have not been able to convince myself that I could do any better. I used to be told that one should never enter an infected area but should make another wound entirely separate and drain through the opening. It has always made me shudder to see an otologist open an abscess in the mastoid, put a hemostat through the dura and allow spinal fluid to come out. I have always been sure that meningitis would occur, but to my surprise it has occurred in few cases. I think the answer is that the spinal fluid washes the infection outward and the opening is soon closed by edema and adhesions. So when infection is just getting into the cranial cavity I am satisfied to let the otologist do what he wishes and see what will occur. I have not been able to make any suggestions as to what else to do and have always hoped that the otologist would produce a cure in that stage. After that period is over, if a patient begins to acquire an abscess of the brain, I feel more inclined to take a hand and try to do something for him.

DR ERIC OLDBERG. I wish to thank Dr Bailey for his discussion and to repeat that my experience has been most favorable with conservative methods of treatment. I have resorted to radical methods only when the former have failed.

PSYCHONEUROTIC SYMPTOMS IN OTOLARYNGOLOGIC PRACTICE DR ALFRED P. SOLOMON (by invitation)

A classification of the clinical manifestations of psychoneuroses is presented, objectifying the problem of their management by the otolaryngologist

The conversion hysterias, conversion aphonia, deafness, anosmia and loss of taste, are exemplified and their symptoms discussed. The importance of recognizing that conversion hysteria represents a satisfying psychoneurotic adjustment to an emotional conflict or conflicts is stressed. The psychoneurotic adjustment is distinguished from the secondary gain achieved by the presenting symptom in securing attention, interest and sympathy. The problem of treatment in relation to the unconscious purposefulness of this phase of the conversion symptom is explained.

Anxiety hysteria, hypochondriac fixation, schizophrenic hypochondria and manic-depressive somatic delusions are presented as a second group, because the patients seek treatment for somatic symptoms without organic basis. Common to all is an anxious wish to be treated palliatively or surgically in the presence of rejection of the recognition of the conscious or unconscious emotional problem involved. Much emphasis is placed on the fact that the patients prefer organic explanations and that their oft expressed willingness to submit to an operation is not evidence of the organic nature of the complaint.

This group is superficially differentiated by the response of the patient to reassurance by the attending physician. The nature of the transference relationship is explained.

The patients with anxiety hysteria are shown to be grateful for reassurance and more eager than those with the other psychoneuroses of this group to listen to a psychogenic explanation.

The hypochondriac fixations are exemplified by case reports to bring out the deep-seated intensity of the fixation ideology and the attending dangers of doing anything surgically about the symptoms. It is pointed out that the patients resent reassurance. This is contrasted with their characteristically vituperative demands for surgical treatment.

The schizophrenic hypochondriac patients are shown to be even more refractory to reassurance and to be even poorer operative risks. Such treatment often intensifies the condition. A warning is issued about the paranoid tendencies that sometimes follow operation on such a patient.

The patients with manic-depressive psychoses with somatic delusions, the latter often so prominent that the consequent demands for treatment mask the primary depression, are grateful for reassurance but are unable to hold the relief from anxiety thus gained, although they are even more suggestible to hints dropped that a pathologic condition may exist when the anxiety is thereby increased. The deep-seated feeling of guilt existing in this disease is shown to motivate the symptoms.

Another type of condition, psychoneurosis induced by the use of artificial aids, is described, with attention drawn to the fact that the artificial aid is objected to because of reasons which are related to previous personality problems. If these emotional conflicts are kept in mind when the use of the artificial aid is discussed with the patient, the wearing of it is made much easier.

#### DISCUSSION

DR FRANCIS L. LEDERER: Lest Dr Solomon's paper be taken facetiously, I wish to say that this constitutes to my mind one of the most important subjects that could come before the society. It can well be said that if one eliminates the commonplace things from practice one will have no practice, but I think it is better to say that if one eliminates the psychoneuroses one eliminates most of one's practice. If careful consideration is given the many conditions which Dr Solomon has so well presented, physicians will recognize many of the patients who have consulted them. One must have a feeling of guilt for having abetted psychoneurotic persons in many instances. It is common practice, if no organic disease is found, to resort to swabs, sprays and tampons. I do not know whether

Dr Solomon's treatment is better or more effective than that, but I feel that in many cases the condition has been made worse by the classic therapy. Since I have availed myself of the experience of men in Dr Solomon's field, I have found many interesting entities such as he has presented tonight. Perhaps he could more adequately have covered the ground had he given more case reports, and those present would recognize their Mr Joneses and Mrs Smiths, for whom tonsils were removed or other treatment was given but whose symptoms did not subside, and the physician justified himself by thinking that he did them no harm and perhaps some good. I have found suggestive therapeutics a serious menace in this special field of medicine. I am reminded of the patient who comes in with some small growth on the tongue and thinks it is carcinoma. The physician knows it is lymphoid tissue but he removes it to impress the patient. Then he thinks he has reassured the patient with a negative report of the biopsy, but the patient comes back and the physician applies silver nitrate, and finally the patient becomes discouraged and the same process repeats itself in many other hands. This is only one of the many typical acts in the course of special practice.

I think one can study these problems with interest and profit thereby.

DR. ALFRED P. SOLOMON: I wish to thank Dr Lederer for what he has said. He has indicated that he has a clear understanding of these problems.

I do not offer a method of treatment but merely make a plea that physicians understand what they are doing and why they do it.



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## OSTEOMYELITIS OF THE FRONTAL BONE

### REPORT OF EIGHT CASES

RICHMOND MCKINNEY, M D

MEMPHIS, TENN

For several years an increasing amount of attention has been given to osteomyelitis originating in the frontal sinuses and extending to the frontal bone, with a growing recognition of the clinical importance of this condition

The following notes and conclusions are deducted from observations made on a series of patients coming to the charity service of the John Gaston Hospital in Memphis. The surgical work was done largely by my associate Dr Charles K Lewis, of the department of otolaryngology of the University of Tennessee College of Medicine, and the pathologic study by Dr Leo Harris, of the laboratory of that institution

Although one writer, Woodward, concluded that osteomyelitis as a complication of frontal sinusitis is comparatively rare and that no one has reported more than 3 cases occurring under his personal observation,<sup>1</sup> my observation has been that in the majority of cases of osteomyelitis of the frontal bone the frontal sinuses have been the source

In our service at the John Gaston Hospital there have occurred during the past two years not less than 12 cases of osteomyelitis of the frontal bone. The histories of 8 cases are presented here, and in several of these cases the frontal sinuses definitely were the point of origin. Frequently, traumatism of a sinus is an active factor in producing the disease

The patients ranged in ages from 13 to 40 thus bearing out the assertion that since this is a condition involving the diploe, the more marked development of this tissue during adolescence and young adult life is largely instrumental for the greater incidence of osteomyelitis in the period before middle life

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Read at the Sixtieth Annual Congress of the American Laryngological Association Atlantic City, N J, May 4, 1938

1 Woodward F D. Osteomyelitis of the Skull. Report of Cases Occurring as the Result of Frontal Sinus Infection with *Staphylococcus Pyogenes-Aureus*, J A M A 95 927-930 (Sept 27) 1930

The pathologic picture of this condition has been so thoroughly presented by Mosher and Judd<sup>2</sup> and various others, especially by Mosher, that it scarcely is necessary to go into this in the present report of cases. Suffice it to say that the infection found in most of our cases was predominantly staphylococcic, although other bacterial organisms may have been present. This infection, as is well known, extends by the diploic veins, with localized abscesses in the bone marrow.

The symptoms are clearly defined, for usually edema and frequently redness extend from the orbital ridge to the hair line rather quickly, and there is a low grade septic rise in temperature, although the patient may be free from fever. In only 2 of our cases, however, was there a definite leukocytosis.

The diagnosis in a number of the reported cases has been made on the basis of the clinical symptoms alone, without microscopic evidence of pathologic changes in sections of bone, but doubtless osseous changes were present, as the clinical findings were so definite.

I am of the opinion that this condition occurs much more frequently than would be judged from the number of cases reported and that in some cases in which the diagnosis is merely chronic frontal sinusitis the infection is in reality complicated by osteomyelitis.

This is an insidious disease, and unless of the fulminating type, in which development of the process is rapid, the amount of involvement of bone found at operation may be surprising. One of our patients was subjected to three operations before we were convinced that all of the diseased bone was removed.

While extensive removal of the frontal bone, including the inner table, may be necessary, the dura rapidly becomes covered by granulations, and the soft tissues thicken and afford ample protection to the brain. We have not observed our patients who were operated on long enough to note the regeneration of bone seen by Furstenberg,<sup>3</sup> but doubtless a certain amount of regeneration does definitely occur in the younger patients during the course of years.

In operating on these patients we have not followed any definite procedure but mainly have sought to remove all of the diseased bone, which can be done only by thoroughly reflecting the soft tissues covering the frontal bone and then biting and chiseling the cheesy bone away until what is judged to be normal bone is encountered. The amount of bone to be removed at times is appalling, but without thorough removal, operation is useless. Roentgenograms are useful as guides but are occasionally misleading, as bone macroscopically apparently in good condition is sometimes undergoing osteomyelitic changes.

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2 Mosher, H. P., and Judd, D. K. *Laryngoscope* **43** 153-212 (March) 1933.

3 Furstenberg, A. C. *Tr. Am. Laryng. Rhin. & Otol. Soc.* **36** 434-439, 1930.

The mortality rate in our series was about the same as that reported by others. 3 of the 8 patients died 1 of meningitis another from abscess of the brain and another from a concurrent bronchopneumonia. Lewis<sup>4</sup> found the mortality rate much higher after an operation on a sinus in which conclusion I must concur.

The treatment is essentially surgical prompt and thorough in order to avoid possible indeed probable leptomeningitis abscess of the brain or thrombophlebitis.

With these brief introductory remarks, I shall report more or less in abstract owing to their large number the cases comprising this series. Three of the most interesting are given in detail. Complete records with roentgenograms the report on the blood chemistry and other details are in the hospital files but could not be given other than synoptically.

#### REPORT OF CASES

CASE 1—W. K. a white boy 13 years of age was admitted to the Isolation Hospital on Nov. 2, 1936, with a diagnosis of erysipelas. This provisional diagnosis was made because there were redness and swelling of one side of the face extending from the supraorbital arch to the hair roots which had been present for several days prior to admission. Roentgenograms showed extensive involvement of the ethmoid cells and also involvement of the frontal sinus on that side. Immediately the ethmoid cells of this side were drained with the patient under general anesthesia but in a short while pansinusitis developed and the frontal and ethmoid sinuses were then drained. The frontal bone was found to be soft and bluish typically osteomyelitic in appearance. The child being diabetic, had little resistance, and three days later meningitis developed which brought death on December 7. The white blood cell count just before the first operation was 8520.

This case was undoubtedly one of fulminating osteomyelitis beginning in the ethmoid cells. Owing to the child's general condition I doubt very much indeed if treatment, however radical and early, would have been of any value in preventing the fatal termination.

CASE 2—B. L. a Negro aged 40 was admitted to the hospital on Dec. 29, 1936 with the history that he was struck over the glabella with a cotton scale six weeks before admission. His temperature averaged around 101 F when he was admitted to the hospital and he was poorly developed and poorly nourished. Roentgenograms showed what was apparently osteomyelitis of the frontal bone, nasal bone and ethmoid cells. The white blood cell count was rather low being 3650.

On December 31 the patient was given ether and an incision was made along the right eyebrow down to the bone. The periosteum of the right frontal sinus was elevated and a piece of necrotic bone was removed, pus and granulation tissue being curetted from the frontal sinus down to and including the nasal bone and the nasal process of the maxilla. This was removed and the wound was packed with iodoform gauze.

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<sup>4</sup> Lewis, C. K. Memphis M. J. 13:27-29 (Feb.) 1938.

On Jan 7, 1937, there apparently being more involvement of the bone, the previous incision was reopened after anesthetization with procaine hydrochloride, and the discoloration of the bone was found to extend farther toward the floor of the frontal sinus and over the bridge of the nose. The discolored bone was removed, and a quantity of granulations and necrotic bone was cleaned out of the ethmoid capsule. On January 19, since the wound was not healing as satisfactorily as was expected, it was reopened, the anesthetic being administered intratracheally this time, and the edges of the bone previously exposed were found to be in good condition with the exception of a small area over the bridge of the nose. This was removed, and from that time on the man had an uninterrupted convalescence.

The pathologic laboratory reported that the sections of bone showed chronic osteomyelitis.

This case is interesting in that it showed that failure to remove even the smallest portion of diseased bone when there are osteomyelitic changes may continue to give rise to unfavorable symptoms. Further, it may be of some interest to note that three different kinds of anesthetic were used for the three different operations, for no especial reason, however.

CASE 3—W. H., a Negro 23 years of age, was admitted to the hospital with the history of swelling and inflammation in the right eye for three or four days before admission, which he thought were due to a cold in the head. Cellulitis was present in the right eye, the temperature ranged from 101 to 102 F., the leukocyte count was 13,600, and the patient appeared toxic. There was decided tenderness over the right frontal bone. Roentgenograms showed increased density of the right antrum and right ethmoid cells, apparently due to the presence of fluid.

The next day, with the patient under nitrous oxide and ether anesthesia, the bone over the right frontal sinus was removed, and a quantity of foul-smelling pus was liberated. The ethmoid sinuses were opened, and the bone was found to be necrotic. Bluish, soft bone above the right orbit was extensively removed. The patient was later discharged to the outpatient department and in a short while was discharged as cured.

The bone removed was not examined by the pathologic laboratory, but it had the typical appearance of osteomyelitic bone.

CASE 4—T. M., a Negro aged 22, was admitted to the hospital in February 1937. He stated that he had been struck over the left eye seven months before, after which a swelling developed, which ruptured, leaving a fistula discharging thick creamy pus. There was no fever. His leukocyte count was 9,450. On the basis of a roentgen examination the diagnosis of chronic unilateral pansinusitis, with present activity, was made.

With the patient under colonic anesthesia, the right frontal sinus was opened, and the bone surrounding the fistula was found to be necrotic. This was removed, and the sinus was cleaned of pus and granulations. The pus showed a growth of *Staphylococcus aureus* of the hemolytic type. The laboratory reported that the specimens of bone removed revealed chronic osteomyelitis.

The wound continued to drain, and the patient returned to the hospital for reoperation on two occasions. The last time, in October 1937, roentgenograms showed some cloudiness of the frontal sinus but no extension of the osteomyelitis. Anesthesia was induced intratracheally this time, and the old incision was

reopened. The disease of the bone was found to be progressing not only along the cut edges of the bone but over the right frontal sinus and well up on the frontal bone in the midline. The bone showed the characteristic discoloration and moth-eaten appearance of osteomyelitis.

All bone that appeared to be diseased was removed, the resection being carried back into the bone around this area in an effort to remove all traces of osteomyelitis. The dura was covered by granulation tissue. The denuded field was painted with iodine, the dura was covered with a greased iodoform pack, and the scalp was closed, as is usually done at operation in cases of this character. Skin clips were used on the edges of the scalp to control bleeding.

Postoperative treatment, besides the usual irrigations with saline solution and the administration of sedatives, consisted of the administration of large doses of sulfanilamide and two transfusions of blood. The man was discharged a month after admission, with only a small gap between the eyebrows still open. When seen over three months afterward, he was free from any further symptoms of osteomyelitis. At this time he was cautioned to come into the outpatient department every day for dressing. This he failed to do, and after about three months he presented himself at the office in a serious condition. He had gone to Mississippi, where he was working, and had permitted the wound to close too quickly, with the result that an epidural accumulation of pus developed. He was immediately sent to the hospital, where an effort was made to save his life by establishing drainage, but in a short while he died from toxemia.

CASE 5—H. M., a Negro aged 19, was admitted to the hospital in September 1936, with a complaint of purulent discharge from the right eye with swelling of the lid of two days' duration. Roentgenograms made on his admission showed marked cloudiness of the right ethmoid cells with only moderate involvement of the other corresponding accessory sinuses. Through an external opening the ethmoid cells were drained of a thick white pus. Shortly afterward, the patient was discharged, apparently much improved, and was instructed to return to the outpatient department, where he could be kept under observation pending subsidence of the acute symptoms. Two months later he was readmitted to the hospital, the incision not having healed, there was a small fistula, from which pus was draining. There was no pain or fever, and his general condition was good.

With the patient under colonic ether anesthesia, the old incision was reopened and enlarged, and the bone covering the right frontal sinus and ethmoid cells was found to be necrotic, with pus in the frontal bone. Resection of this bone was carried up to what was apparently healthy tissue, and the man was discharged on March 9, 1937. Since then, so far as is known, there has been no recurrence. The laboratory diagnosis was chronic osteomyelitis.

CASE 6—M. H., a Negro aged 25, was admitted to the hospital on Sept. 25, 1937, with pansinusitis of the left side and spontaneous rupture of the corresponding frontal sinus; he also had bronchopneumonia. About two weeks before his admission headache and pain in the left eye developed, the eye began to swell and became inflamed, discharging a purulent material. The patient had some fever and light rigors, all of which increased in severity up to the day of his admission. There was a leukocyte count of 13,200.

An external incision was made, and the frontal bone was exposed. This was found to be necrotic, bluish and cheesy, and thick pus was evacuated from the frontal sinus and ethmoid cells of this side. The patient's condition would not admit of further operative treatment, and he was returned to the ward for observation. The temperature continued to follow a septic course, and a blood culture on March 10 was reported positive for *Streptococcus haemolyticus*. This



septic condition, together with bronchopneumonia, which the patient had at the time of admission, was responsible for his death on March 16. The bone removed showed chronic osteomyelitis.



Fig 1—Photomicrograph showing spaces of bony absorption (1) in which degenerated bone cells are visible, also irregular haziness of osteoid tissue, denoting a destructive process. Osteoblastic activity in the margins of bone is indicated by 2 and chronic inflammatory cell infiltration by 3.

CASE 7—M. H., a Negress aged 39, entered the hospital complaining of pain and tenderness over the eye and forehead of one year's duration. These symptoms increased in severity, until they were almost unbearable. She ascribed the origin of this trouble to an acute cold in the head.

Edema and tenderness were found over both supraorbital regions, extending upward to the hair line. Roentgenograms of the bone underlying this area showed it to have a moth-eaten appearance. The temperature was 100 F and the total white cell count 9,400.



Fig 2—Photomicrograph showing osteoblastic activity in the margins of bone (2), with regeneration of bone. Spaces of bony absorption are indicated by 1 and chronic inflammatory cell infiltration by 3.

Anesthetization was obtained with avertin and procaine hydrochloride, and an incision was made supraorbitally. This was bisected by a vertical incision extending up beyond the edematous area, forming two triangular flaps. When the flaps

were retracted, the bone was found to be dark purple and necrotic. A triangular section of the bone was removed, and with it a fragment of dura about the size of a 5 cent piece. The dura was discolored and bled freely, but there was no indication of abscess formation. Because of loss of blood and the uncertainty



Fig 3—Photomicrograph showing chronic inflammatory cell infiltration (3) characterized by a few polymorphonuclear leukocytes, plasma cells and many lymphocytes. In addition, a desmoplastic reaction is noted. Spaces of bony absorption are indicated by 1 and osteoblastic activity in the margins of bone by 2.

of blood donors for a transfusion, it was decided to postpone the completion of the operation until later. The laboratory reported that the bone showed chronic osteomyelitis.

After a weeks interval during which the patient received 550 cc of blood intravenously avertin was administered and the incision was reopened. The remainder of the diseased bone was removed with enough of the normal bone to insure a reasonable margin of safety. Iodine was painted over the dura and bone, a greased iodoform pack was placed over the dura and drains were inserted. The edges of the scalp were then pulled loosely together to prevent retraction. The postoperative treatment consisted of the administration of large doses of sulfanilamide, irrigation of the wound with physiologic solution of sodium chloride and another transfusion. Convalescence was uneventful and four months after operation there was found no sign of an active pathologic process.

CASE 8—M. R., a Negress aged 22, was admitted to the hospital complaining of a severe pain over the right antrum and eye with headache, fever and regular chilly sensation for the past three weeks. There was periorbital edema of the right eye and cheek with extension of the edema toward the hair line of the corresponding side. There was a white blood cell count of 17,900. According to the roentgenographic report there was chronic pansinusitis with fluid in the right antrum and the right frontal bone appeared osteomyelitic.

An external frontal resection was done with removal of the bone high on this side. The patient was discharged from the hospital a number of days later but returned in about a week with extension of the inflammation upward from the right frontal sinus.

With the patient under intratracheal anesthesia the right frontal sinus, the ethmoid sinuses and the antrum were again cleaned out and cheesy bone was removed for some distance above the right frontal sinus. This was found to be osteomyelitic. When the patient was seen a number of months later she was free from symptoms and appeared to be entirely well.

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## PREOPERATIVE MANAGEMENT OF ACUTE STREPTOCOCCIC MASTOIDITIS

E MILES ATKINSON, M D, F R C S (Eng )

NEW YORK

When Ambroise Pare said that he dressed the wounds but God healed them, he was enunciating in the metaphysical manner of his age a physiologic fact of profound importance. Without the presence in the body of those defensive and reparative mechanisms which come into action as the result of injury, whether mechanical or bacterial, the organism could not survive, but Paré alone of his age appreciated and acknowledged this fact. Four hundred years later we of the medical profession are scarcely less ignorant of what immunity actually is. Immune bodies, opsonins and the like, are, when all is said and done, only postulates to explain a pathologic theory, not proved facts, however much we may delude ourselves. Yet without this defense mechanism, whatever it may be, all our therapeutic skill and surgical technic would be unavailing. In the treatment of acute infections in particular we are dependent for success on its adequacy. Without such resistance, without response to invasion by a pathogenic organism, the patient must die, while the doctor stands impotently by.

In the days before Lister, when a surgical operation was a hazardous adventure for both patient and surgeon, the physician was content to await the localization of an infection, as made manifest by the presence of an abscess, in order that the minimum of surgical interference, with its attendant risks and pain, should be necessary. With the advent of anesthesia, the appreciation of antiseptic and aseptic principles and the improvement in surgical technic, the art of surgery leaped ahead and operations began to be undertaken which before were beyond contemplation. It must be almost unbelievable to the present generation of students that it was only in 1866 that Lister began to operate antiseptically in a cloud of carbolic acid spray, that the first successful operation for a tubal pregnancy was done by Lawson Tait in 1883, before which time the condition was regarded as invariably fatal, and that when in 1901 the coronation of Edward VII was postponed on account of acute appendicitis and Treves undertook to operate, all medicine held its breath at the risk of a royal laparotomy.

As time went on and experience accumulated, surgery was divested of its fear and operation came to be undertaken more readily and more easily, until one passed in the space of fifty years from an era virtually

asurgical to one of superabundance. Nowhere was this excess more in evidence than in the right iliac fossa, unless it was in the tonsillar region. Judgment gave way before dexterity. Not least was this the case in the treatment of acute infections. As a result to a great extent of the success of early operation in abdominal emergencies, and especially in the treatment of acute appendicitis, it became the custom to open areas of infection at an increasingly early stage, without thought for the underlying pathologic process. In cases of streptococcic infection of the finger, that lethal condition to which the medical profession is particularly liable, the area was widely incised, and extensive operations were performed on acutely inflamed bones at the earliest opportunity, regardless of the fact that immediate appendectomy depends for its success on removal of the entire infected organ with its contents. When this condition does not apply, when infection occurs in an organ which cannot be excised in its entirety, the arguments in favor of early surgical intervention fall to the ground. Then the function of therapy is to await and encourage localization of the infection and the formation of an abscess, which is to be incised for the sole purpose of giving exit to pus as and when it is formed. Premature surgical intervention before the formation of an abscess can do nothing but harm by opening fresh tissue spaces to infection and interfering with mechanisms of defense which have already come into play.<sup>1</sup>

In the mastoid region this argument applies with especial force. Here is a bony structure which cannot be excised—moreover, a structure which more often than not is widely pneumatized and whose air cells are directly continuous with other groups of air cells which honeycomb, to greater or lesser degree, the petrous portion of the temporal bone. Furthermore, its roof, a thin sheet of bone, is also the floor of the middle fossa of the skull and presents only a tenuous barrier to invasion of the cranial cavity. A virulent infection of the mastoid, then, is pregnant with danger. If ill timed intervention is allowed to interfere with the natural protective processes, infection may be widely spread, and with dire consequences. Exenteration of a mastoid process even of diploic type before localization has occurred opens up a large area of fresh and unprotected tissue through which direct invasion of the blood stream can take place. Infection, likewise, can pass through cells in the petrous portion of the temporal bone to the apex, there to produce an abscess or meningitis or both, or the meninges may be infected directly from the mastoid itself. These calamities are not mere speculative possibilities—they happen.

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1 Handfield-Jones, R. M. Infections of Fingers and Hand, *Lancet* 2 833 (Oct 10) 1936

## TYPE OF MASTOIDITIS

The type of mastoiditis with which these disasters are likely to be suffered is only too well known to otologists. It appears in the course of an epidemic of influenza, of infection of the upper respiratory tract or of a specific fever. The organism is nearly always a streptococcus of a virulent strain, usually hemolytic. The history is that of an acute illness, which may be improving when there is complaint of sudden earache and rise of temperature. The drum head, which in the early stages is injected only, rapidly becomes scarlet and edematous, if it is incised, a thin serous fluid teeming with organisms, usually hemolytic streptococci, exudes from the middle ear in small quantity. In twenty-four hours or so there is definite, increasing and extending tenderness of the mastoid, and the patient is alarmingly ill, with all the evidence of a severe intoxication—high temperature, rapid pulse, dry skin, furred tongue, extreme lassitude. In rare instances of a fulminating infection, invasion of the blood stream occurs apparently coincidentally with that of the ear and carries off the victim within two or three days, usually with meningitis. A patient of mine, a woman of 56, died within thirty-six hours of onset. She went to bed one night apparently well, having been nursing her son through influenza, and woke up in the night with earache, when seen by me a few hours later, she already had early signs of meningitis. She died next morning, overwhelmed by the infection, with not a flicker of reaction to it.

It is obvious that operation cannot avail in such a case, but probably every otologist has fallen at some time into the temptation to operate in the early stage of a less severe infection. If so, he has found an acutely inflamed bone which oozes profusely blood and a thin serous fluid full of organisms, but nowhere pus, nowhere a cavity, nowhere any sign of limitation—an uncharted sea of bleeding bone. If he is fortunate, there follows only a stormy ten days, but not infrequently septicemia ensues, from which the patient is lucky if he escapes with no worse than a fixation abscess in joint or pleura (chart 1).

The course of wisdom, however, is not to operate, which means that one will have to withstand the natural desire of anxious relatives for action. This stand not uncommonly requires considerable courage to maintain, for if an operation has been performed, even if the result was not successful, it is always thought that at least all was done that could be done, while if the face of the physician has been set inflexibly against operation and ultimately the outcome is fatal, doubt invariably creeps into the minds of the relatives as to the wisdom of the course adopted, and this doubt is not concealed. In these days a greater self confidence and a larger judgment are required to withhold operation

than to advise it. Nevertheless, I am convinced that such an attitude is right and that a serious complication has never been warded off in a case of streptococcic infection by premature surgical intervention. It may be objected that sometimes one's hand is forced by circumstances, such as threat of meningitis. I submit that the onset of the complication will only be hastened by intervention before the infection has been brought under control. Sir David Wilkie, of Edinburgh, referring to acute infection of the finger, put the matter succinctly. He said "You only need three things when you are called to such a case—a Bier's bandage, a 40 cc syringe full of antitoxic serum, and a cheerful countenance. You can leave your knife at home!"

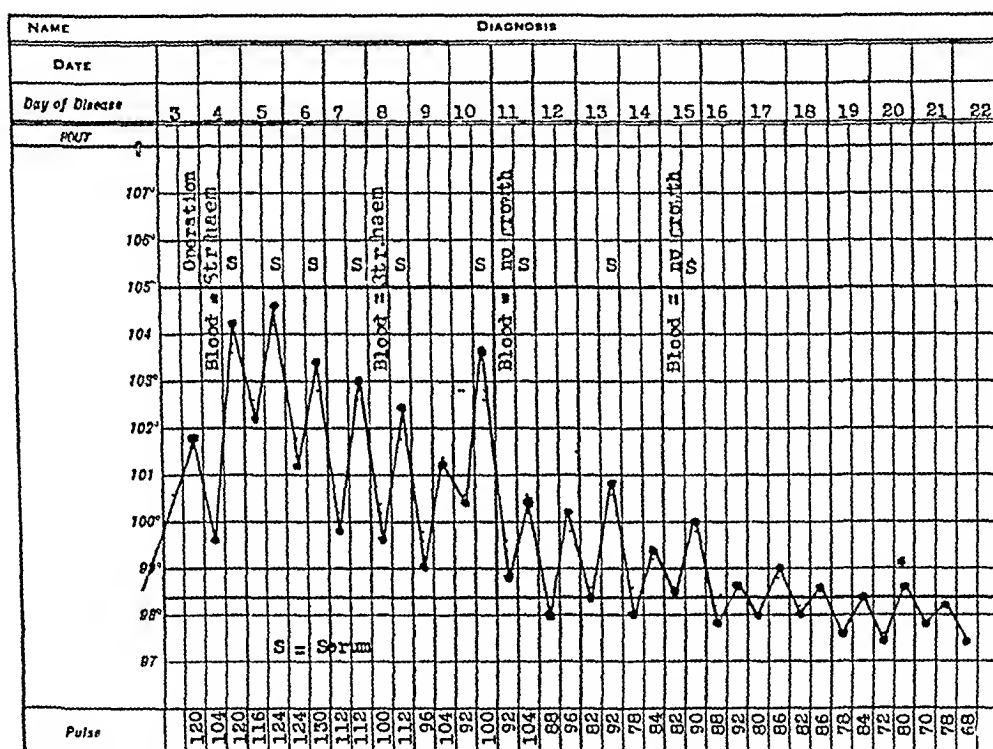


Chart 1—Operation was performed on the third day of illness due to infection of the ear. The blood culture, unfortunately, was not made before, but was positive after, operation. Note (1) the sharp rise in temperature on the tenth day, after omission of serum on the ninth, and the slight rise on the thirteenth and fifteenth days, and (2) the still unsteady temperature at the end of the third week.

#### PREOPERATIVE MEASURES

*General Measures*—If operation is denied, one does not therefore stand idle. Patients with mastoiditis are suffering, at the best, from bacteremia, if not active septicemia, and much can be done to help them collect their forces against the attack. In the first place, they are shocked by the sudden onslaught, shocked and anxious. They need physical and mental rest. Nothing can give that to them better than morphine. I am always at a loss to understand the prejudice which will



withhold the benefits of morphine from the many because of its abuse by the few. Paget, who once suffered from septicemia, paid a glowing tribute to this drug. Absolute rest in bed, then—not a hand's turn should the patient do for himself—preferably out of doors, and morphine, are the immediate desiderata. The diet is fluid, and extra fluid should be forced. If it cannot be taken by mouth in sufficient quantity it must be given by rectum, into the subcutaneous tissues, or by continuous intravenous drip. Local heat should be used to relieve pain and to increase the blood supply. It can be applied by the homely hot water bag, the electric pillow or a short wave apparatus.

*Antitoxic Serum*—In addition to these general measures, more specific measures can be undertaken, and among these I have deliberately given pride of place to serum. Specific serum is used in streptococcic disease to a much greater extent in Europe than in America, though even there opinion is divided as to its efficacy. Lord Horder<sup>2</sup> and Sir David Wilkie, for instance, advocated its use, Professor Ryle<sup>3</sup> was unconvinced of its value. I believe that this was due partly to the variation at that time in the potency of different serums and partly to pusillanimous dosage. As for myself, I am a firm believer in serum. I have seen case after case in which the whole picture has changed after its administration—too many to be mere coincidence. I have records of cases in which the temperature dropped immediately after administration of serum and remained down, to rise when serum was stopped too soon and to fall again on its resumption (charts 1 and 2). There are, however, two essentials to the satisfactory use of serum. The first is that the serum must be polyvalent and of known potency, for serums vary much in this respect. The one I was accustomed to use in England, with excellent results, is unfortunately not obtainable in the United States, but the one<sup>4</sup> I have employed here has proved nearly as satisfactory, no doubt other serums are equally good. The second essential is that the dose must be adequate. Forty cubic centimeters given intravenously is not too much as the initial dose for an adult with a severe infection, and the sooner it is given the better. Administration of serum should be continued in doses of half that amount, given intramuscularly, at first daily and then every second day until the infection is brought under control. It is probably unnecessary to issue a warning against giving the first dose without previously determining whether the patient is sensitive, but the precaution is needed in these days when preventive

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2 Horder, T. Observations on the Treatment of Septicemia, *Brit M J* 2 594 (Oct 3) 1931

3 Ryle, J. A. Natural History, Prognosis and Treatment of Streptococcal Fever, *Guy's Hosp Rep* 81 1 (Jan) 1931

4 Prepared by Parke, Davis & Co, Detroit

serums are so frequently used Desensitization can be achieved, when necessary, in two hours

*Nuclemic Acid*—This drug is reputed to stimulate leukocytosis, and clinical experience endorses the claim<sup>2</sup> I place it here not because it comes second in order of merit but because it can conveniently be given intramuscularly every second day, in alternation with serum It is useful to add strychnine and sodium cacodylate for their tonic effects A suitable prescription is

Sodium cacodylate	0.03 Gm
Solution of strychnine (B. P.)	0.06 cc
Nuclemic acid (saturated)	to 1 cc

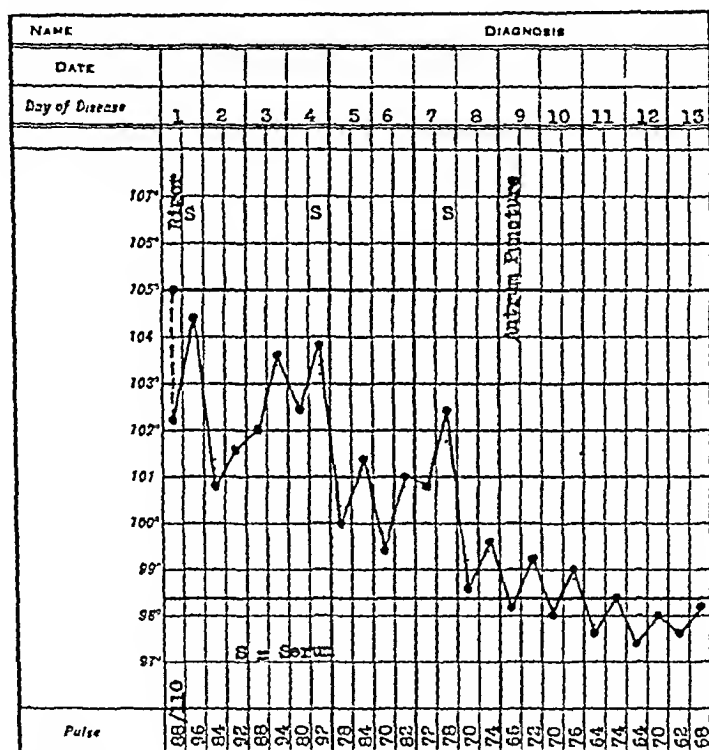


Chart 2—Acute streptococcic pansinusitis arising during the course of scarlet fever, on the third day after appearance of the rash The dose of serum was inadequate, but the chart shows well the reaction to serum on each occasion and settling of the temperature at a lower level There was no operative treatment other than simple puncture of the antrum on the ninth day

*Blood Transfusion*—There is no need to sing the praises of this procedure here Indeed, one would like to apply a brake, for one sees it used so frequently without discrimination Transfusion is not a cure for all the ills that flesh is heir to, nor is it entirely without risk As far as it concerns the present matter, the case may be put thus, that in the absence of a satisfactory serum, transfusion should be employed, and preferably an immunotransfusion Ideally, blood from several donors should be tested for titer against the offending organism and

the serum with the highest titer selected. Failing that, any compatible blood will supply fresh leukocytes and antibodies which are of benefit, though its main effect is probably more that of helping the accompanying anemia than of combating the infection. The quantity given should be small, not more than 250 cc for an adult, for it is not difficult to overload an acutely intoxicated heart.

*Sulfanilamide and Allied Compounds*—This drug also needs no advocacy, it is suffering as it is from too good a press. Like transfusion, it is no panacea, but unfortunately, as a result of certain spectacular achievements and an initial social success, it has been used indiscriminately by and for all and sundry. Granted that it has had a number of dramatic successes and that in the realm of aural surgery it has altered entirely the outlook for hemolytic streptococcic meningitis,<sup>5</sup> yet it must be used with discretion and with due appreciation of its limitations. Thus, there is so far no convincing evidence that the drug is of value in combating any streptococcus that is not hemolytic. Further, in infections of the middle ear, even when the hemolytic type is the offender, the results so far have been disappointing, the reason for which may lie in the relative poverty of the blood supply to the middle and inner ear. Again, the drug is not without its dangers, although, unfortunately, it can be bought casually across the counter. Reports are increasing of cases in which agranulocytosis<sup>6</sup> and other forms of anemia<sup>7</sup> follow its use, and the liability to a marked decrease in the hemoglobin content of the blood is well known, so it is essential that examinations of the blood should be made at regular and frequent intervals during its administration. Nevertheless, there is no doubt that the drug is a useful addition to the physician's armamentarium, and it is to be hoped that it will not be killed, like others before it, by too much enthusiasm.

*Shock Therapy*—Of how much justification there is for the artificial production of a fixation abscess by injection of turpentine I am not sure. I have had no personal experience with the procedure, but some favorable reports have been given. Certain it is that when nature performs the same function the outlook immediately improves, so that one has come to regard empyema or an infected joint as the turning of the tide, however unfortunate in other ways it may be. On these

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5 Weinberg, M. H., Mellon, R. R., and Shinn, L. E. Two Cases of Streptococcic Meningitis Treated Successfully with Sulfanilamide and Prontosil, *J. A. M. A.* **108** 948 (June 5) 1937.

6 Young, C. J. Agranulocytosis and Para-Amino-Benzene Sulphonamide, *Brit. M. J.* **2** 105 (July 17) 1937.

7 Harvev, A. M., and Janeway, C. A. The Development of Acute Hemolytic Anemia During the Administration of Sulfanilamide (Para-Aminobenzenesulfonamide), *J. A. M. A.* **109** 12 (July 3) 1937.

grounds it would seem that shock therapy should have its uses but that it should be employed late in the disease

### SIGNS OF LOCALIZATION

Eventually from about seven to ten days after the onset of the infection of the mastoid, a change begins to be apparent in the patient. He who previously has been apathetic and listless becomes bright and alert, the sallow skin becomes clear, the dull eye bright and the dry furred tongue clean and moist. At the same time, the temperature falls from the 103 or 104 F mark and begins to take on a swinging character.

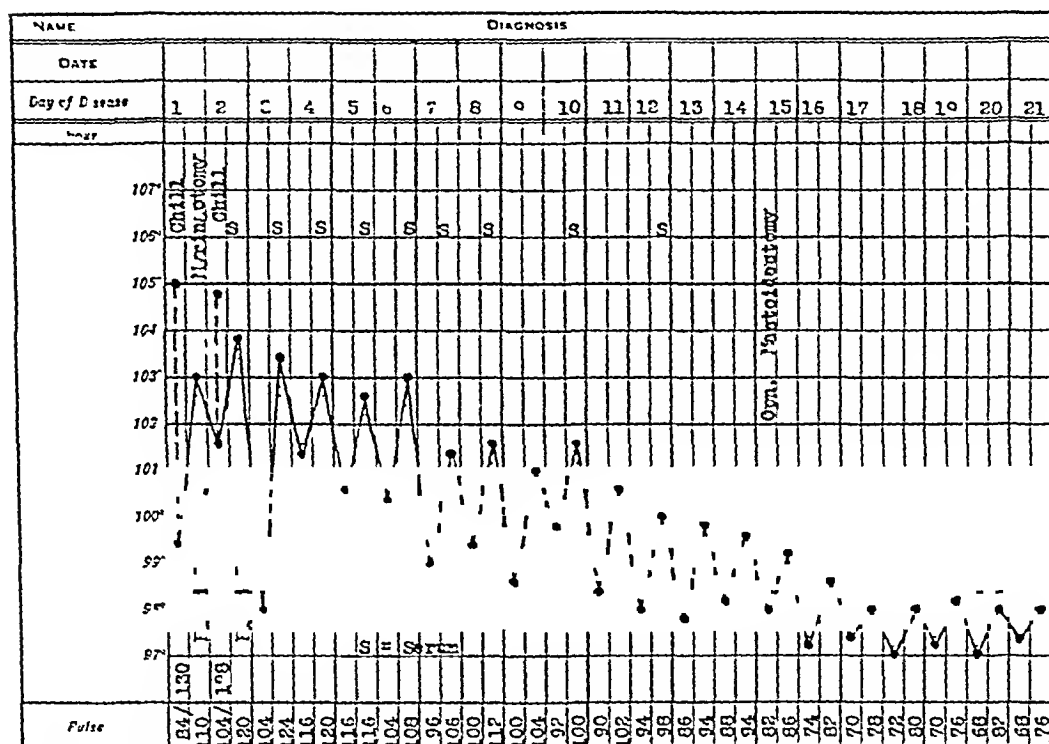


Chart 3—Infection of the middle ear on the sixth day of illness arising during recovery from acute nasopharyngitis. Note the protein shock following intravenous injection of serum. Operation, which was not performed until the fifteenth day, revealed localized abscess of the mastoid. Note the absence of disturbance following operation.

being normal in the morning and 100 to 101 F in the evening, while the pulse steadies. The blood picture which possibly showed leukopenia at first, now shows leukocytosis with a count of 20,000 or more, and the tenderness of the mastoid which was diffuse becomes more definitely localized. Still it pays not to be in a hurry. The changed clinical picture should be allowed to stabilize itself, and the temperature to settle or to take on a definite swinging character for two or three days before operation is undertaken (chart 3). I have on occasion

delayed three weeks before operating. Operation then will reveal the presence of pus, probably localized in a cavity, in any event with the limits of its extent clearly defined, the postoperative course will be smooth and free from anxiety, and healing will take place rapidly.

### RESULTS

It is difficult to speak of results because of the difficulty of accurate comparison. It is impossible to say that a certain patient would have died had operation not been performed immediately, any more than it is possible under opposite condition to maintain the reverse. In an attempt to get something concrete with which to support the view put forward

#### *Results of Immediate and Delayed Operation in Two Groups of Patients with Acute Staphylococcal Mastoiditis*

	Operation	
	Immediate 1926 1931	Delayed 1932 1935
Total number of patients	19	14
Patients with meningitis	2 (both died)	0
Patients with petrositis (Gradenigo's syndrome)	3 (1 died)	1
Postoperative septicemia	3 (all had a fixation abscess and recovered)	0
Average number of days in hospital	33	27
Number of patients with complications	8	1
Number of deaths	3	0

in this paper, I went through my private records for the years from 1926 to 1935 inclusive and picked out the cases of mastoiditis which came into the category under discussion. There were 33 cases in all, and these I divided into two groups: one of 19 cases from 1926 to 1931 inclusive, the period when I was still under the influence of false teachings and operated immediately on all mastoids with obviously acute infection, and one of 14 cases from 1932 to 1935 inclusive, when I followed the lines I have advocated here. The results are shown in the accompanying table. It will be seen that of the 19 patients operated on without delay, 8 had complications, 3 of whom died, while of 14 patients treated expectantly only 1 had any complication and none died. There were infections of as great severity in the second group as in the first. Further, the average length of stay in the hospital for the first group was thirty-three days, and that for the second, only twenty-seven days.

## SUMMARY

An argument is put forward for delay in operation in cases of acute streptococcic mastoiditis until localization of infection has occurred. Preoperative management and the indications for operation are discussed. The results of immediate and of delayed operation as they have appeared in my practice are presented in a table and show that when the expectant treatment is adopted there are fewer complications, a lower mortality and a shorter period of hospitalization.

570 Park Avenue

# OSTEOMA OF THE MASTOID PROCESS

STANTON A. FRIEDBERG, M.D.

CHICAGO

Of the bony tumors of the skull, those of the external auditory canal and of the accessory nasal sinuses are perhaps the most commonly encountered by the otolaryngologist. Osteoma of the mastoid process is infrequent in occurrence, Haymann<sup>1</sup> in 1919 was able to find but 8 authentic cases. Since that time, reports by Frankel,<sup>2</sup> Bruzzi<sup>3</sup> and Breyre<sup>4</sup> have appeared. Because of this dearth of clinical material and the absence of any comparable data in the American literature, it was deemed advisable to record the following case.

## REPORT OF A CASE

M. S., a Negress aged 52, came to the otolaryngologic clinic at Cook County Hospital early in December 1937 because of a hard mass behind the right ear, which had been slowly increasing in size for ten years (fig. 1). The patient recalled a severe blow by a fist on the involved area approximately two years prior to the initial appearance of the growth. There had been no symptoms other than the progressive enlargement of the tumor and occasional transitory mild pain in the affected region. There was no history of earache, aural suppuration or tinnitus. Occasional dizzy spells had occurred after an abdominal operation, but these were unaccompanied by nausea, headache or falling. Six years previously the patient began antisyphilitic therapy, which was continued for three years. Since the conclusion of this treatment frequent Wassermann tests of the blood, the last one in November 1937, had given negative reactions. No other member of the patient's family had been known to have any similar type of growth.

On examination, the teeth were found to be in excellent condition. There was a rounded bony mass on the hard palate at the intermaxillary and palatomaxillary suture (torus palatinus). Examination of the nasal passages and the pharynx gave essentially negative results. The accessory nasal sinuses were equally and clearly visualized on transillumination. There was no cervical adenopathy. Just

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Read before the Chicago Laryngological and Otological Society Feb. 7, 1938.

From the departments of otolaryngology, Cook County Hospital and Rush Medical College.

1 Haymann, D. Zur Kenntnis der Knochengeschwulste des Warzenfortsatzes (Osteoma eburneum processus mastoidei), *Ztschr. f. Ohrenh.* **78** 23-32, 1919.

2 Frankel, I. Osteoma of the Mastoid, *Ztschr. f. Hals-, Nasen- u. Ohrenh.* **30** 623-626, 1932.

3 Bruzzi, B. Osteoma of the Mastoid Apophysis, *Boll. d. mal. d. orecchio, d. gola, d. naso* **51** 263-266, 1933.

4 Breyre, C. Osteoma of the Mastoid Apophysis, *Liege med.* **28** 557-558, 1935.

posterior to the right auricle and overlying the entire mastoid process except the tip there was a round smooth immobile bony mass measuring 4 by 3 by 1.5 cm. The auricle was displaced anteriorly and the external auditory canal was slightly narrowed. The right tympanic membrane was unchanged. The left ear was normal in all respects. Functional testing of the cochlear and the vestibular system gave entirely normal results. Complete physical examination failed to disclose any other bony tumors.



Fig 1—Osteoma of the right mastoid process with slight anterior displacement of the auricle

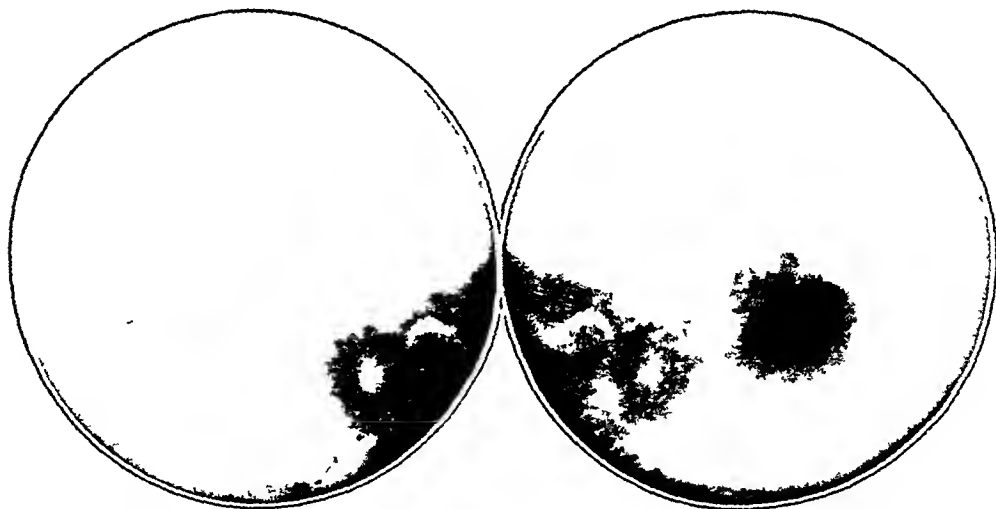


Fig 2—Osteoma overlying the posterior-superior portion of the right mastoid process

Urinalysis and two Wassermann tests of the blood gave negative results. Determination of the blood calcium showed 11.2 mg per hundred cubic centimeters. Roentgenograms showed a pneumatized mastoid process with a dense opaque shadow in the posterior-superior portion, which was thought to be an osteoma (fig 2). Roentgenograms of the accessory sinuses, taken subsequently, showed no abnormalities.

At operation performed with nitrous oxide anesthesia by Dr L. T. Curry the usual mastoidectomy incision was employed. The tumor was covered by a layer of periosteum which was easily separated. The mass was firmly attached



to the cortex of the mastoid, and the upper portion overlay the remnant of the squamomastoid suture. Removal was begun with a gouge. After several small chips of bone had been cut away, the entire tumor was cleanly dislodged from the underlying cortex, which was seen to be intact though slightly roughened. The skin and periosteum were closed with silkworm mattress sutures, and a gutta-percha drain was inserted. Healing of the wound was uneventful.

*Pathologic Examination*—Gross The specimen was a hemispherical bony tumor measuring 3 by 2.5 by 1.5 cm. The surface was smooth everywhere except on the posterior margin (where bone had been surgically removed) and on the slightly concave medial aspect, which marked its attachment to the mastoid cortex (fig. 3). In the latter region there was a small localized adherent layer of periosteum measuring 1 cm in length and 1.5 mm in depth. After partial decalcification in 10 per cent nitric acid, the tumor weighed 9 Gm. A surface made by cutting through the mass revealed a homogeneous and uniformly compact white, ivory-like structure.

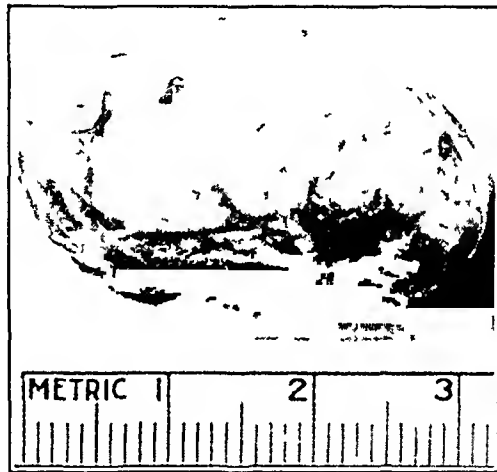


Fig. 3—Osteoma of the mastoid process after surgical removal. The anterior and the concave medial surface are shown, the latter being the site of attachment to the mastoid process. This area appears darker on the specimen, and on it a longitudinal strip of thickened isolated periosteum can be seen.

*Microscopic* In sections of the tumor stained with hematoxylin and eosin, the osseous structure was of the mature compact type (fig. 4). The haversian systems were surrounded by regular, concentric lamellae. The majority of the lumens were small, and in several regions the canals contained a fibrillar structure which by its distribution suggested the presence of fat cells; no evidence of osteoblastic activity was apparent.

#### ETIOLOGY

Constitutional factors and diatheses were formerly thought to be of significance in the etiology of this condition, although Haymann<sup>1</sup> was unable to establish any causal relationships between osteoma and rheumatism, gout or syphilis in the cases which he carefully analyzed. In this connection, the history of syphilis in the present case is perhaps worthy of reconsideration despite the fact that antisyphilitic treatment

apparently had no retarding effect on the growth. A possible disturbance of calcium metabolism was brought to mind by the associated palatal osteoma, but the blood calcium content was within the range of normal. The more frequent occurrence of these tumors in females and their appearance only after puberty have been generally recognized as sig-

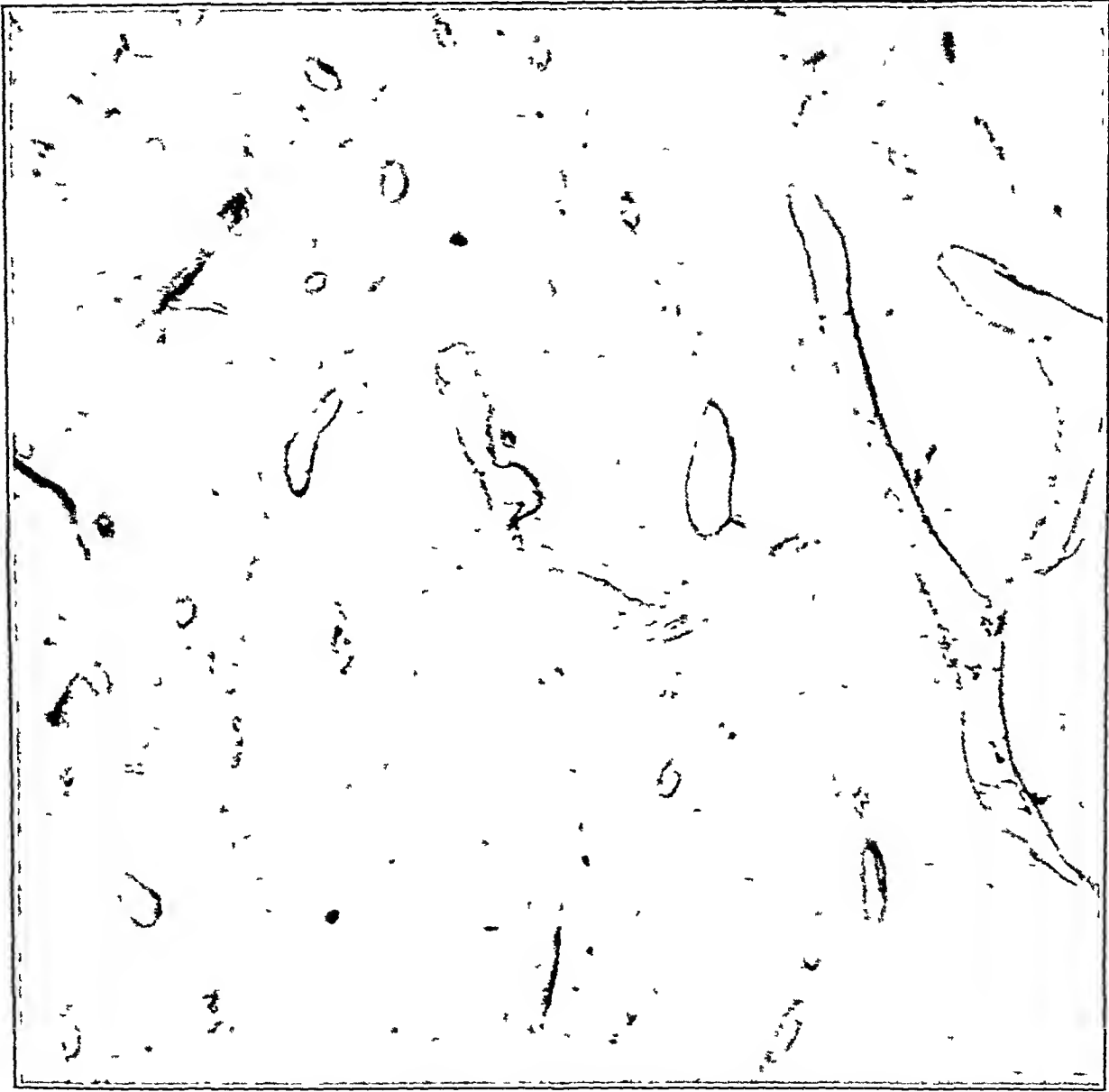


Fig 4—Section of compact bony tissue from the tumor stained with hematoxylin and eosin

nificant. A hereditary tendency has been described in relation to multiple exostoses.

Trauma with subsequent ossifying periostitis doubtless serves as a predisposing influence in some instances while in others injury may appear to be the actual exciting cause. In the case under discussion several points might justifiably cast doubt on the traumatic origin of

the tumor first, the concomitant presence of the palatal neoplasm, second, the well known tendency on the part of patients to attribute their condition to some previous incident, and, finally, the fact that the injury antedated the appearance of the growth by at least two years

A chronic inflammatory process has doubtless been the underlying agent in some cases. An osteoma of the mastoid process described by Vandervoort<sup>5</sup> occurred in a patient with chronic suppurative otitis media of forty years' duration. A similar description has been offered by Korosi.<sup>6</sup> Germán<sup>7</sup> reported the accidental discovery of twelve small bony tumors within the mastoid process during an operation for chronic otitis media. There is no evidence that disease of the middle ear played any role in this case.

Finally, it should be remembered that the appearance of the tumor may be unattended by any assignable cause.

#### PATHOLOGY

According to Ewing,<sup>8</sup> "Circumscribed overgrowth of bone occurs under such a wide variety of conditions, and the distinctions between inflammatory and neoplastic hyperplasia of the tissue are so often obscure, that it has never been possible to exactly define the limits of osteoma." Osseous tumors of two different types occur in the temporal bone. First, large tumors located in the mastoid process and seldom in the squama, and, second, smaller tumors located superficially in the os tympanicum.<sup>9</sup> In the latter group belong the well known exostoses of the external canal.

Bony tumors of the mastoid process usually occur singly, project in rounded fashion from the surface and occasionally encroach somewhat on the lumen of the external meatus. Their size may be considerable, as in Weinlechner's<sup>10</sup> case, in which the growth weighed 30 Gm. When the tumor has its origin in the substance of the bone itself and grows centrally rather than peripherally, it may be described as enostosis (Vir-

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5 Vandervoort, cited by Buck, A. H. *Diseases of the Mastoid Process: Their Diagnosis, Pathology, and Treatment*, translated, Arch f Augen- u Ohrenh **3** 1, 1874.

6 Korosi, cited by Frankel.<sup>2</sup>

7 German, T. Multiple Small Bony Tumors in the Mastoid Process, Ztschr f Hals-, Nasen- u Ohrenh **18** 339-349, 1927.

8 Ewing, J. *Neoplastic Diseases*, ed 3, Philadelphia, W. B. Saunders Company, 1934, p 213.

9 Henke, F., and Lubarsch, O. *Handbuch der speziellen Pathologie und Histologie*, Berlin, Julius Springer, 1926, vol 12, pp 498-500.

10 Weinlechner, J. Osteoma of the Mastoid, Monatschr f Ohrenh **20** 341-343, 1886.

chow). Kretschmann<sup>11</sup> emphasized the importance of suture lines in the skull as sites of predilection. In a report concerning the development of an osteoma at the parietosquamooccipital juncture this author proposed an analogy between sutures in the skull (particularly in the region of the fontanels) and the epiphyses of long bones thereby attempting to establish a relationship between the types of exostoses in the respective areas. In passing it might be mentioned that such a theory deserves consideration as it offers an explanation for the topography of the tumors for their appearance after puberty and for the hitherto unexplained occurrence of osteomas of the nasal accessory sinuses.

Grossly these tumors are composed of homogeneous ivory-like bone. Microscopically the tissue consists of compact bone with solid lamellae and sparse haversian canals. The term osteoma eburneum most accurately describes the structure. Occasionally cancellous tissue or marrow spaces predominate. These variations may be regarded as yielding some clue as to the origin of the growth. In Kretschmann's case the tumor exhibited a fibrous stroma in which were embedded multiple minute structures consisting of lamellated bony substance. The term osteoma conglomeratum was suggested. The origin was in all probability the periosteum, and the lesion was probably an ossified fibroma.

To quote again from Ewing:<sup>5</sup>

Histological study fails, as a rule, to distinguish simple hyperplastic bone from true osteomas. When originating in bone both processes show a participation of some or many osteoblasts which surround the edges of the new growth and add to its substance from one or many sides. Both processes yield dense lamellated bone with few Haversian canals or spongy bone with many vessels and abundant narrow spaces and cells. The gross and clinical features seem to form the best criteria by which to separate osteoma from simple hyperostosis.

#### SYMPTOMATOLOGY

The typical osteoma of the mastoid process produces no symptoms. Occasionally there may be pain or tenderness on pressure, particularly if extension medially involves the inner table of the skull. Obstruction of the auditory canal may result in impaired hearing, a symptom which would also occur in association with a suppurative process in the middle ear.<sup>12</sup> Bruzzi's<sup>3</sup> patient lamented the disturbance created by the bony protuberance to the nun's headgear which she wore. Cooper's<sup>13</sup> patient was "very desirous of having it removed in consequence of its interference with her bonnet strings."

11 Kretschmann. Osteoma of the Skull Bones, *Verhandl. d. deutsch. otol. Gesellsch.* Dresden, 1910, p. 305.

12 Burger, H. Inner Osteoma of the Mastoid, *Monatschr. f. Ohrenh.* 65: 1447-1450, 1931.

13 Clinical Records, *Lancet* 1:628, 1861.

## DIAGNOSIS

The diagnosis is not difficult if the examiner is aware of the infrequent occurrence of such tumors. Roentgenograms may establish the true nature of the neoplasm or, as exemplified by Claus's case, be responsible for its discovery<sup>14</sup>. Whether the status is benign or malignant should be determined. Retroauricular cysts would not be expected to cause any diagnostic uncertainty.

## TREATMENT

Surgical removal of osteoma of the mastoid process is indicated when distressing symptoms accompany the growth of the tumor or for cosmetic reasons. Otherwise, the usual benign character of the growth may be explained to the patient and its presence disregarded.

## SUMMARY AND CONCLUSIONS

Osteoma of the mastoid process is rare.

A case is reported in which the tumor was associated with a comparable growth on the hard palate.

Frequently, as in the case of most neoplasms, no definite cause can be ascertained, although trauma or chronic inflammation may be a predisposing agent.

The tumor is usually benign. It is composed of compact bone, and the differentiation between simple hyperplasia and true osteoma may be difficult.

The symptoms are often negligible, and surgical removal, when indicated, offers practically no difficulty.

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<sup>14</sup> Claus, G. Exostoses in Accessory Sinuses and Mastoid Cells, *Ztschr f Hals-, Nasen- u Ohrenh* **22** 223-227, 1929.

# OSTEOMA GROWING FROM THE MASTOID CORTEX

GEORGE M COATES, M D

PHILADELPHIA

Osteoma in the region of the mastoid is believed to be a rarity. It can be classified as a true osteoma, or bony neoplasm, rather than as an exostosis or hyperostosis. The osteoma seen by the otolaryngologist is usually in the lumen of the frontal sinus or in the ethmoid capsule. A hurried and incomplete search of the literature and personal communications from a number of pathologists and otologists confirm the impression that few reports of similar growths in the region of the mastoid cells have been made.

## REPORT OF A CASE

J K, aged 39, an executive in an insurance company, in 1927 had his attention called by his barber to a painless swelling on the left side of the head, behind the ear and just within the hair line. He was unable to associate any trauma with this growth, there was no pain and the skin over the mass was freely movable. As the tumor did not subside but seemed to grow slowly larger, he consulted Dr J Gershon-Cohen, a prominent roentgenologist. Dr Gershon-Cohen took roentgenograms of the head in 1932 and reported that a small hard bony tumor, about 1.5 cm in diameter, was located at the superior-posterior angle of the left mastoid. It sprang from the outer table, was well circumscribed and extended into the diploe but was not invasive. The right mastoid was well developed and normal, the left mastoid was not so well pneumatized as the right. The lateral sinus stood out more clearly on the left side and faded completely from view just at the site of the bony tumor.

A roentgenogram taken April 6 showed an osteoma on the left mastoid just at the upper posterior course of the pneumatic portion. It sprang from the outer table, was uniformly calcified and measured about 1.5 cm in diameter.

The patient was referred to me on June 6, 1932, when the growth presented the appearance described. On August 6 he complained of slight pain on the left side of the head and was somewhat apprehensive of possible malignancy. The pain soon subsided, and he was not seen again until June 19, 1936, at which time, as the growth was appreciably larger and worried him by its mere presence, it was decided to remove it surgically. This was done in the Graduate Hospital of the University of Pennsylvania on June 23, with tribromethanol anesthesia. An incision was made directly over the mass, from which the skin and the periosteum were elevated fairly easily. A flat chisel was placed at the junction of the tumor with the cortex, and three light blows of the mallet partially separated the tumor from the skull, it was then pried loose with the chisel and came away easily, leaving the hard outer table of the skull smooth and with nearly its normal contour. The

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Read before the Section on Otolaryngology of the College of Physicians of Philadelphia, Nov 18, 1936

mass was almost circular and measured about  $1\frac{1}{2}$  inches (3.8 cm) in diameter by  $\frac{1}{2}$  inch (1.3 cm) in thickness, being slightly concave at its attachment. It was hard bone but not of the solid, ivory-like consistency of the osteomas usually seen in the sinuses. The wound was closed by skin clips without drainage and a pressure bandage applied. There was no pain or inflammatory reaction after the operation except in the membrana tympani, which became congested and caused mild earache. This subsided in a few days, the clips were removed on the third day and the wound was healed and dressings dispensed with on the seventh. Since then there have been no symptoms and no return of the bony growth.

Roentgen examination by Dr. Gershon-Cohen on August 17 (eight weeks after the operation) showed the bone to be healthy.

The pathologic report by Dr. Eugene Case, of the Graduate Hospital, was as follows: "The tissue shows compact bone, with small marrow spaces filled with fibrillar connective tissue. There is no fat in these spaces. The diagnosis is osteoma."

At one time I thought that the tumor might have invaded or have originated in the pneumatic spaces of the mastoid, but this was not the case, it was entirely external. Unfortunately the specimen was lost in the laboratory, so that a photograph of it cannot be presented. The patient today presents nothing of interest except a hardly distinguishable linear scar within the hair line.

# PLASTIC REPAIR AFTER REMOVAL OF EXTENSIVE MALIGNANT TUMORS OF THE ANTRUM

FREDERICK A FIGI, M D

ROCHESTER, MINN

More effective therapy for malignant tumors of the antrum has produced additional responsibility for the surgeon, that is, the correction of the deformity that at times follows the removal of such a growth. Surgical treatment as a rule leaves no appreciable change in the facial contour provided the lesion has not extended beyond the sinus. However, when extrinsic involvement is present, therapy sufficiently radical to offer a possibility of curing the disease is likely to cause more or less marked deformity of the face. Although the patient may be freed from his malignant disease, he is often left so badly disfigured that he can neither mingle socially nor earn a livelihood. The rehabilitation of the patient, accordingly, is at times as important as curing him of his malignant tumor. Repair of the deformity often presents a major problem in plastic surgery.

Various forms of treatment have been used in dealing with malignant tumors of the maxillary sinus. The prognosis and the tendency to produce external deformity vary greatly with the different therapeutic measures. Resection of the superior maxilla or any of the other cutting operations which were commonly employed a few years ago only infrequently effected eradication when the tumor was confined within the antrum and rarely did so when it had become extrinsic. Moreover, such a procedure often caused considerable external deformity. Irradiation with radium alone or with radium and roentgen rays combined at times produces striking results in cases of a highly malignant tumor in this situation, and a minimal change in the facial contour is likely to follow. The combination of electrocoagulation or actual cautery and irradiation has, however, proved most effective in the hands of the majority of surgeons interested in this field. This type of therapy has been used in dealing with these tumors at the Mayo Clinic since 1917.<sup>1</sup> An opening is made into the antrum through the buccal fold or, if the

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From the Section on Laryngology, Oral and Plastic Surgery of the Mayo Clinic

Read at the Sixtieth Annual Congress of the American Laryngological Association, Atlantic City, N. J., May 2, 1938

1 New, G. B. Treatment of Malignant Tumors of the Antrum, J. A. M. A. 74: 1296-1300 (May 8) 1920



tumor is extrinsic, at the point elsewhere inside the mouth where it approaches nearest the mucosal surface. Usually, the exposure is made by means of electrocoagulation, and destruction of the tumor is effected in the same manner. At the completion of the operation radium is packed into the antrum, especially into those portions of the cavity where the thoroughness of the removal is questionable. With this type of treatment 40 per cent of five year cures have been secured in the cases of primary tumor of the antrum, and 53.4 per cent of five year cures have been secured in the cases in which the involvement of the sinus was secondary to a malignant tumor of the upper jaw.<sup>2</sup> In view of this relatively good prognosis it seems appropriate that serious consideration be given to the repair of deformities incident to the treatment of these tumors. The literature contains few references to their correction. The inference would seem to be that the patient and his physician have been content with arrest of the malignant process and have not taken cognizance of the functional and cosmetic aspects. The most detailed considerations on the repair of these deformities that I have been able to find have been that of Ohngren,<sup>3</sup> in his excellent monograph "Malignant Tumors of the Maxillo-Ethmoidal Region," and that of Beck and Guttman.<sup>4</sup>

Whether or not external deformity will result after removal of a malignant tumor of the antrum in this manner depends largely on the situation and the extent of extrinsic involvement. If the growth is limited to the sinus, no appreciable change in the contour of the face is likely to develop postoperatively even though the neoplasm completely fills the antral cavity and thorough cauterization of the entire bony wall is necessary. Maintenance of a large opening into the antrum is desirable in all cases in order to permit of inspection for possible recurrence for at least a year after the operation. This is insured in the usual case by wide electrocoagulation of the area of approach on the anterior antral wall. If the tumor has eroded through the bony palate or is causing bulging of the alveolar process and is situated directly beneath the mucous membrane of the mouth, in which event it is exposed at one of these points, the perforation will be in the corresponding situation. While an opening here is more bothersome to the patient than one through the anterior wall of the antrum, it is readily closed with a

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2 New, G. B., and Figg, F. A. Malignant Diseases of the Mouth, Pharynx and Larynx. Five-Year Cures, Surg., Gynec. & Obst. **60** 483-484 (Feb 15) 1935

3 Ohngren, L. G. Malignant Tumors of the Maxillo-Ethmoidal Region, Acta oto-laryng. **19** 1-476, 1933

4 Beck, J. C., and Guttman, M. R. Plastic Repair of a Facial Defect Following Operative Treatment of Carcinoma of the Antrum and Upper Jaw, S. Clin. North America **14** 775-782 (Aug) 1934

special dental plate and accordingly is of no serious consequence. The most common external deformity is retraction and elevation of the upper lip and the angle of the mouth. This occurs not infrequently after removal of a primary tumor of the antrum that is entirely intrinsic. It is encountered more frequently, however, in cases in which the growth has perforated the anterior wall of the alveolar process and in cases in which the antrum is involved secondarily by a malignant neoplasm of the anterior part of the upper jaw. It is due to contraction of the scarring in the soft tissues overlying the anterior wall of the antrum and that resulting from loss of the mucous membrane in the labial sulcus and on the inner surface of the upper lip together with loss of the underlying bony support. Perforation externally through the cheek into the antrum is one of the most conspicuous deformities occurring in this connection. It is likely to develop only in cases in which the lesion has eroded through the anterior wall of the antrum and is infiltrating the skin or the subcutaneous tissues directly beneath it. At times this defect is large and opens directly into the mouth and nose as well as into the antrum. In fact, it is often much larger than was anticipated in view of the very limited involvement of the skin and subcutaneous tissues, because of the tendency of the thinned-out skin to roll inward as healing occurs. When the tumor is already perforating the cheek, it is usually of decided advantage to carry out the electrocoagulation through this area, as an opening in the roof of the mouth may thereby be avoided, while an external perforation is bound to occur in any event. Not infrequently, when the neoplasm has eroded through the upper part of the antral wall or the floor of the orbit sequestration of the lower orbital border or of a portion of the malar prominence may result. Complete loss of the eye is not a rare occurrence in these cases. The ocular globe is at times destroyed by the heat of the electrocoagulation or by the reaction from the radium used inside the antrum, when perforation of the bone was not present previously. The patient should always be warned of this possibility. In some instances, even though there is loss of the entire lower portion of the bony orbit, the eyeball miraculously remains unharmed and the vision in the eye unimpaired. However, considerable deformity and interference with function develop in these cases, since the eye recedes and sags markedly, it is supported only by a hammock of soft tissue, and diplopia, often of pronounced degree, results.

Displacement of the orifice of Stenson's duct occurs frequently as healing takes place within the antrum. This is due to traction of the scarring on the mobile mucous membrane lining of the cheek. In the usual case this altered position of the orifice is of no consequence, and

the patient is not even aware of it. Rarely, however, the opening of the parotid duct may be drawn so high upward and anteriorly into the antrum that saliva drains into the nasal fossa and thence from the nostril.

The optimum time for repair of the deformity is an important consideration. Opinions vary greatly in this regard. In the clinic of Professor Pichler in Vienna, which I visited recently, resection of the superior maxilla is carried out for the removal of the tumor, and if sacrifice of the full thickness of the cheek is necessary an immediate plastic closure is done even though this requires bringing up a flap from the neck and thorax. To the majority of surgeons, as to the professor's own assistant, this procedure seems daring. On the other hand, some surgeons prefer to delay proceeding with correction of the deformity for from two to four months. At the Mayo Clinic it has been regarded as an unjustified procedure to undertake repair before the patient has been free from evidence of the malignant disease for approximately a year, and it is common to wait much longer. This tides the patient over the period during which there is greatest likelihood of recurrence. I have, however, observed a return of the growth after approximately two years in several instances. This delay also permits the sequestrum to separate, the margins of the defect in the cheek and palate to heal over and the inflammatory reaction to subside. While a plastic closure can often be made much more readily immediately after excision of the tumor, as one does not then have the scarring and fixation of the tissues to contend with, there is a considerable risk of covering a small portion of the neoplasm that has not been completely removed. Should a recurrence develop beneath the grafted tissues, its recognition will be much longer delayed than it would have been if the defect had been left open. Sacrifice of a varying amount of the graft, together with a considerable portion of the adjacent normal tissue, would then be necessary. Moreover, when immediate repair is planned, there is often a tendency for the operator to save questionable tissue, sacrifice of which would increase the difficulty of closing the wound.

Procedures for the repair of the defects in the palate and cheek vary greatly, depending on the situation and size of the perforation, the training of the surgeon and whether or not the services of a competent dentist are available. A perforation in the palate or alveolar process may be dealt with surgically, but as a rule it is better closed with a special denture. This is made to furnish any teeth which it has been necessary to sacrifice, and it is held in place by means of clasps about the remaining upper teeth. In case the upper jaw is edentulous, spring clasps that overlap the margins of the defect or spring supports that are attached to the lower teeth or denture are required. There is

rarely sufficient mucoperiosteum remaining on the palate to permit of surgical repair, and a skin flap is not satisfactory for this purpose in most cases. While a cutaneous flap effectually occludes the opening, it remains soft and flabby and is not sufficiently rigid to withstand the suction necessary to hold an artificial denture in place. The dental plate worn over such a skin flap accordingly requires special mechanical support, and in most instances it might better have been used for closure primarily.

When a perforation through the cheek also is present, the denture used to close the palatal opening may be made to support a prosthesis for closure of the former as well. Such a prosthetic appliance is not infrequently employed for this purpose, although most patients much prefer to have a defect in this prominent situation repaired with their own tissues. At the Mayo Clinic a mechanical means has occasionally been used for closure temporarily, until it seemed safe to proceed with plastic repair. The prosthesis can be made sufficiently inconspicuous to enable the patient to resume his work during this period (figs 1 to 4).

In most instances repair of a perforation through the cheek will require bringing in tissue from a distance by means of a pedicle flap, although if the opening is small a satisfactory closure can often be made by paring the margins and directly approximating them after wide undercutting. This is the simplest type of closure, it requires a single operation and a minimum amount of time, usually not over a week. On the other hand, when a pedicle flap is necessary multiple operations, with several periods of hospitalization over a longer time, are involved.

A flap for this purpose may be secured from the forehead, neck, arm, thorax, back or abdomen. The most useful sites are the forehead and the thorax. For women the temporofrontal or the frontal region is frequently the site of selection, as the hairdress can be made to conceal the skin graft and scar on the forehead effectually. For men, the thorax is usually preferable, as the scarring in the frontal region is unduly prominent unless the patient has a very thin skin. Flaps from the forehead possess the decided advantages of proximity and vascularity, which make it possible to transfer them more rapidly, the color and texture of the skin of the forehead also render the repair less conspicuous. If a flap is taken from this region it is possible to complete the repair in from four to six weeks. A flap taken from the thorax for repair of a defect in the cheek must be tubed, which requires an additional surgical procedure. Moreover, the great length of the flap required for this purpose and the comparative avascularity of the tissues over the upper portion of the thorax necessitate a delay of at least three months after the tubing to permit a satisfactory blood supply to develop in the upper pedicle. The outstanding advantages of such a flap are



Fig 1—Extensive recurring squamous cell epithelioma (grade 3) of the left antrum, upper jaw and cheek of a man aged 51. The tumor is bulging and about to perforate the cheek.



Fig 2—Fungating tumor presenting in the roof of the mouth of the patient shown in figure 1.



Fig 3—Left, patient shown in figures 1 and 2, nine months after the removal of the tumor by electrocoagulation and radium. In addition to the large perforation in the cheek there was destruction of the bony floor of the orbit and of the nasoantral wall, a large perforation was present in the roof of the mouth. Right, same patient. Metastasis into the cervical lymph nodes was present. The lymph nodes have been removed.



Fig 4—Patient shown in the preceding figures, four years after the removal of the malignant tumor of the left antrum. The perforation in the cheek and that in the roof of the mouth have been repaired with a tubed flap from the thorax.

that an almost unlimited amount of tissue for repair is secured and that the resultant scarring is on a covered portion of the body. The chief disadvantages are the greater length of time required and the fact that the repair is more conspicuous, as the color and texture of the skin do not match that of the rest of the face (fig 5).

It is essential that the portion of the flap to be utilized in repairing the perforation be lined. This may be accomplished by turning under



Fig 5—Above, postoperative perforation of the cheek following removal with electrocoagulation and radium of extensive recurring epithelioma (grade 3) of the left upper jaw, antrum and cheek. Below, same patient after closure of the perforation with a tubed flap from the thorax.

the distal end of the flap on itself, but a full thickness skin graft is usually preferable, as its application requires no more time than the former and the part of the flap utilized in the actual repair remains thinner, less bulky and more pliable. The cosmetic result also is more satisfactory. At times a lining is secured by turning in a flap of skin from the margin of the defect and covering it with the flap transplanted from the forehead or thorax. This procedure possesses the disadvantage of making it necessary to graft a larger area on the face. When a

free skin graft is used for a lining it must be applied to the flap approximately two weeks prior to transference in order to permit it to become attached firmly

Retraction and elevation of the upper lip and angle of the mouth due to scarring and loss of the bony support of these structures result in a conspicuous deformity. For correction it is necessary to free widely the scarred attachment of the lip and cheek to the superior maxilla and to roll out the mucous membrane which has been drawn upward inside the lip. A Thiersch or shaved skin graft from the arm or thigh, which has been wrapped about dental compound with its deep surface outward, is then applied to the denuded inner surface of these structures in order to restore their lining. The graft is best taken from a surface that is free of hair, for, while it should be cut so thin that hair follicles are not included, there is always a possibility of transplanting some of them into the mouth. The stent bearing the graft is best held in place by means of an appliance attached to the teeth. In the absence of teeth in the upper jaw, the dental compound mold may be fused to the patient's upper denture, or silk sutures may be passed about the stent, through the cheek, and tied over a gauze pad on the outer surface. The jaws are immobilized when feasible by means of interdental wiring, so that the stent and graft will remain firmly in position. The stent is kept in place for ten days. On its removal the graft will almost invariably be found lining the restored buccal fold and firmly adherent. Providing immobilization can be maintained, a thin graft of this type seems to take practically as well within the contaminated oral cavity as on the surface of the body. Unless kept under tension for several months, however, it undergoes marked shrinkage. It is accordingly necessary to replace the dental stent immediately with vulcanite. This must be worn continuously until the permanent prosthesis is ready. If it is left out for only a day at this time, the new buccal fold will be drawn down to such a marked extent that little will be accomplished by the operation. Once the lip and cheek have been mobilized by relining them in this manner, the symmetry of this portion of the face is readily restored with a proper prosthesis (fig 6).

Loss of the inferior orbital border requires either a bone or a cartilage graft. While human cartilage that has been preserved in an aqueous solution of metaphen or that has been freshly removed from the patient's rib may be used for this purpose, it is, as a rule, less satisfactory than bone because of its lack of rigidity. For restoration of the orbital floor and for elevation of the ocular globe, however, it is usually of decided advantage, as it can be shaped more readily than can bone. A bone graft from the iliac crest serves well for restoring the inferior orbital border. It is easily shaped with bone forceps and



is then inserted in a bed prepared by tunneling with scissors in the soft tissues of the upper part of the cheek, through a small lateral incision. With proper beveling of its ends, it will at times remain in position without anchoring. When necessary to anchor it, I have found, driving a short piece of a straight needle through it into the underlying bone serves the purpose well. The needle is inserted directly through the overlying skin and must be so short that its deep end will not protrude into the nose or antral cavity. Its outer end is driven down flush with the surface of the graft. I have never seen this device cause trouble later, and it does immobilize the graft securely.

Displacement of the orifice of the parotid duct as a result of post-operative scarring is rarely so pronounced and in such a situation as



Fig 6—Left, deformity following removal with diathermy and radium of an extensive, recurring grade 4 squamous cell epithelioma of the left antrum, cheek and orbit of a woman aged 53. The tumor had been explored previously through the cheek and was perforating the cheek, sequestration of the bony floor of the orbit and malar bone has occurred, the eye was destroyed by the reaction from the operation and irradiation. Right, same patient, two years after the removal of the epithelioma. The perforation in the cheek has been closed with a flap from the forehead, a graft from the crest of the ilium has been inserted to restore the lower orbital border and malar prominence, the patient is wearing an artificial eye.

to require consideration. In one of the cases which I observed, the opening of the duct was drawn upward into the antrum, and the resultant drainage of saliva from the nostril caused the patient much more annoyance than did the deformity of the distorted upper lip or the speech defect which resulted from perforation of the palate. It necessitated her largely foregoing the pleasure of social affairs, since anes-

thesia over the distribution of the infraorbital nerve rendered it impossible for her to tell when salivary secretion was present in the nostril until it dripped from the nose or ran down onto her lower lip. Inhalation of cold air tended to stimulate the secretion, probably because the absence of the nasoantral wall and the large perforation through the floor of the antrum permitted the current of air to pass directly through the nostril into the mouth. Thus, the secretion was often bothersome while she was on the street. It was especially prone to drip from the tip of the nose as she sat with her head tipped slightly forward at the bridge table or dinner table. Eating caused particularly active secretion. While it was apparent that the meatus of Stenson's duct had been drawn up into the antrum during the process of healing, careful search failed to reveal the site of this opening. In an attempt to correct the condition, the cheek and upper lip, which were bound directly to the margin of the antral perforation by scar tissue, were freed and the denuded surface covered with a skin graft. Although this restored the buccal fold and corrected the facial deformity satisfactorily, the drainage of saliva from the nostril continued as actively as ever.

Further attempts to locate the displaced outlet of Stenson's duct were unavailing until secretion of the parotid gland was actively stimulated by having the patient suck a lemon. The orifice was then found on the anterior wall of the antrum, just above the perforation in the palate. The obvious route of salivary drainage from this point, because of complete loss of the nasoantral wall, was directly into the vestibule of the nose and out through the nasal meatus.

The problem then was either to dry up or to divert the secretion of the parotid gland. It did not seem likely that drying up of secretion could be completely accomplished by means of irradiation or evulsion of the auriculotemporal nerve, and transplantation of Stenson's duct was decided on, although no precedent for this procedure could be found in the literature (figs 7 and 8).

Pentothal sodium (sodium ethyl-methyl butyl thiobarbiturate) was administered, and the parotid duct was readily picked up through a small incision on the inner surface of the cheek, below and posterior to its opening in the antrum. The duct was followed upward and cut across just at its antral opening, and the free end was transplanted into a stab wound in the approximate situation of the meatus of the normal duct. Primary healing occurred, and the new meatus functioned normally. The patient has been fitted with a special denture which satisfactorily closes the perforation in the palate. Her symptoms have been relieved completely.



Fig 7—Patient three and a half years after electrocoagulation of an adenocarcinoma that was filling the left antrum. Elevation of the upper lip has been corrected by relining the lip and labial sulcus with a skin graft. A prosthesis is being worn to support the lip and close the perforation which extends through the roof of the mouth into the antrum.

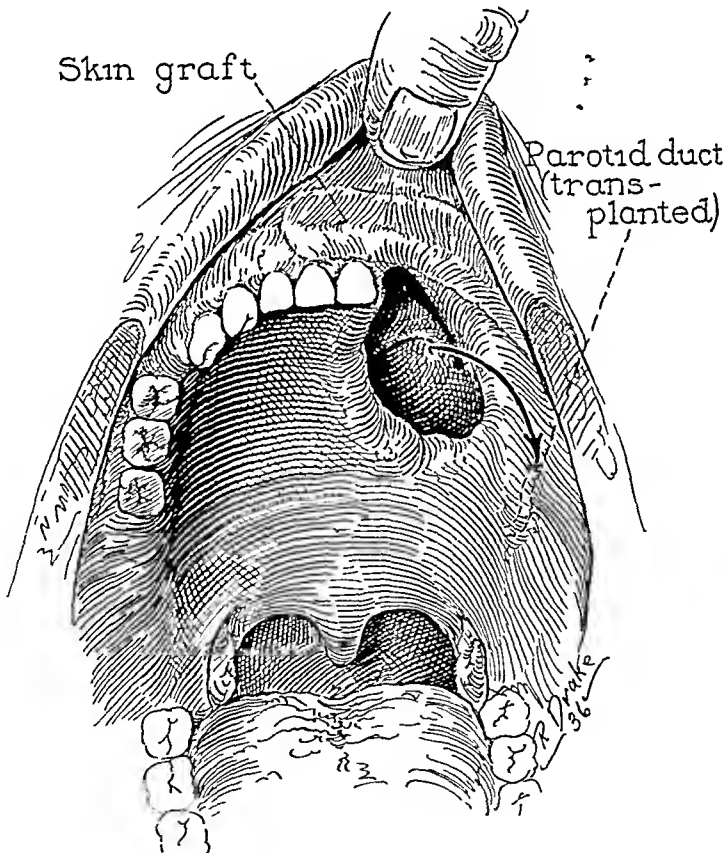


Fig 8—Drawing showing the perforation through the roof of the mouth into the antrum, the transplanted Stenson's duct and the skin graft relining the labial sulcus (same patient as shown in figure 10). The meatus of Stenson's duct had been drawn up into the antrum by the scarring, and saliva was draining into the nose. The meatus of the duct was transplanted into approximately its normal position in the mouth.

SUMMARY

Facial deformity usually does not occur after removal of a malignant tumor of the antrum unless the growth is extrinsic. The most common disfigurements encountered are elevation and retraction of the upper lip and angle of the mouth, perforation of the cheek and nose and loss of the malar prominence, the inferior orbital border and the eye. Displacement of the meatus of the parotid duct rarely is sufficiently marked to produce symptoms. Satisfactory plastic correction of the deformities is possible in most cases.

# IMPROVEMENT OF HEARING IN CASES OF OTOSCLEROSIS

A NEW, ONE STAGE SURGICAL TECHNIC

JULIUS LEMPERT, M D

NEW YORK

The early efforts of Jenkins<sup>1</sup> and Barany<sup>1a</sup> and the recent efforts of Holmgren<sup>2</sup> and Sourdille<sup>3</sup> to ameliorate deafness in cases of otosclerosis by surgical means have led to the conclusion that when improvement in hearing has been obtained by the making of a new fenestra in the bony capsule of the labyrinth the early closure of this labyrinthine fistula by bony regeneration must be prevented surgically in order to maintain this improvement in hearing permanently

Sourdille,<sup>4</sup> who performs what he terms a tympanolabyrinthopexy in three principal stages at intervals of four or five months, stated

In a great number of cases, unfortunately, the success is ephemeral four, six, or ten weeks later, one sees the aerial hearing diminish, the Rinne becomes negative and the Weber indifferent. At the same time, the air pressure in the meatus can attain 40 and even 60 cm of water without determining nystagmus, nor a sensation of vertigo. This is due to the fact that the labyrinthine fistula closes, due to the reconstitution of a rigid bony layer, which rarely attains the thickness of the primitive bony wall of the canal, and more often does not exceed a few tenths of a millimeter. It suffices, in a complementary operation, to extract this bony film, to see the hearing gain of the first operation return, and sometimes be even greatly increased. This time the result will be lasting, the regenerating process of the bone becoming gradually exhausted. In many cases, however, I had to open the labyrinth three times

Sourdille<sup>5</sup> further stated

We must still work to solve this problem of osteo-genesis, which will diminish not only the unpleasantness of reopening the labyrinth, but one of the causes of grave failure—the injury of the membranous canal

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1 Jenkins, G J Treatment of Otosclerosis, J Laryng & Otol **29** 520, 1914

1a Bárány, R Die Indikationen zur Labyrinthoperation, Acta oto-laryng **6** 260, 1924

2 Holmgren, G The Surgery of Otosclerosis, Ann Otol, Rhin & Laryng **46** 3 (March) 1937

3 Sourdille, M New Technique in the Surgical Treatment of Severe and Progressive Deafness from Otosclerosis, Bull New York Acad Med **13** 673 (Dec) 1937

4 Sourdille,<sup>3</sup> p 688

5 Sourdille,<sup>3</sup> p 690

Holmgren<sup>6</sup> asked

How shall the fistulae be made in order to produce the greatest primary improvement in hearing and how shall they later be handled in order to achieve the greatest permanent good? Those are the two important questions demanding attention. Once these are answered, one may expect that the surgical management of otosclerosis will be successful in the hands of those who can maintain the necessary asepsis.

Holmgren<sup>7</sup> said

It is possible to obtain permanently open fistulas of the labyrinth, but up till now this has been the case only occasionally with the material of Sourdille's and mine, and there is not any method known of which is leading to the goal.

The technic which I shall describe provides a surgical means of obtaining a permanently open fistula of the labyrinth by mechanically preventing regeneration of bone by a one stage endaural plastic reconstruction of the auditory mechanism which incorporates the following surgical principles:

- 1 The decompression and mobilization of the labyrinthine perilymph by the surgical construction of a trough-shaped fenestra in the bony capsule of the external semicircular canal.

- 2 The preservation of this surgically created mobility of the labyrinthine perilymph by replacement of the removed area of bony labyrinthine capsule with a suitable and durable membrane which is inserted into the fenestra and maintained permanently in direct contact with the perilymph.

- 3 The arrest of the progressive labyrinthine venous stasis by decompression of the dura of the temporal lobe in the region of the epitympanic recess.

#### TECHNIC

*Preparation of Operative Field*—The mastoid region is shaved. The auricle and the area of skin surrounding it are scrubbed with soap and water, dried and painted with solution of tincture of metaphen. About 5 drops of the solution is then instilled into the auditory canal, and the entire membranous lining of the auditory canal and the tympanic membrane are allowed to bathe in it for a few minutes, after which the canal is dried with a sterile applicator.

*Anesthesia*—A combination of analgesia and local anesthesia is employed. General anesthesia is contraindicated because in order to carry out this technic successfully bleeding must be kept at a minimum and because the cooperation of the patient is necessary during the stage of fenestration of the external semicircular canal.

<sup>6</sup> Holmgren,<sup>2</sup> p. 12

<sup>7</sup> Holmgren, G. Letter, dated April 12, 1938, read by Dr. T. J. Harris at the meeting of the American Otological Society, May 6, 1938.

Analgesia (as outlined by Dr J Branower) Two hours before the time scheduled for operation the patient is given  $1\frac{1}{2}$  grains (0.09 Gm) of neonal (n-butylethylbarbituric acid) and  $1\frac{1}{2}$  grains (0.09 Gm) of sodium pentobarbital (sodium ethyl-(1-methyl-butyl)-barbiturate) by mouth One hour later a hypodermic injection of  $\frac{1}{4}$  grain (0.016 Gm)

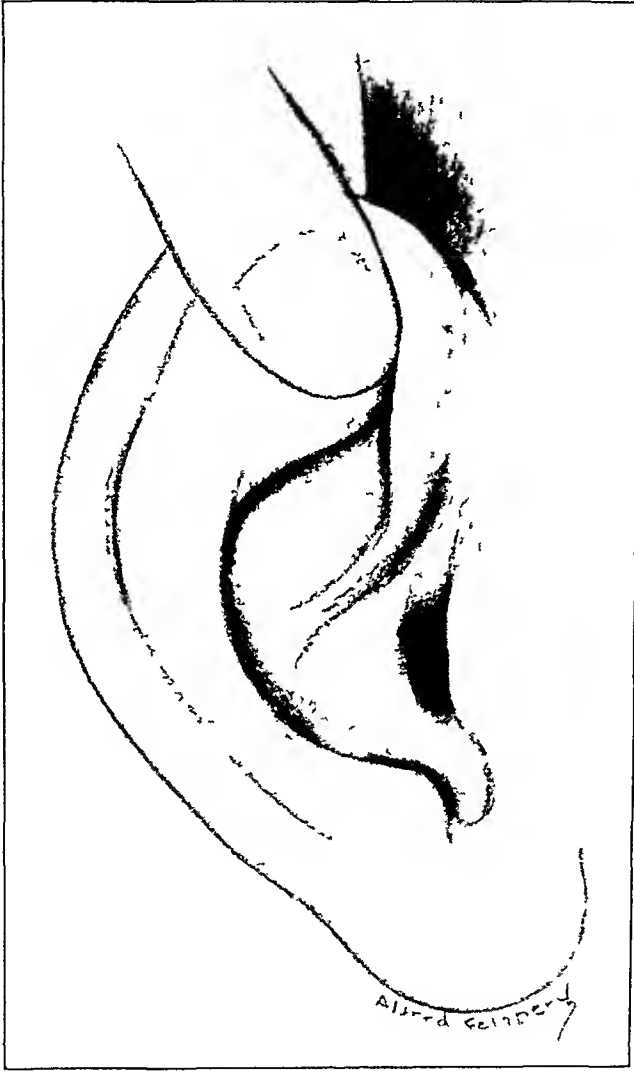


Fig 1—The creation of a mobile endaural membranous and extracartilaginous window for the antauricular surgical approach to the temporal bone, showing the antauricular suprameatal membranous triangle

of morphine sulfate and  $\frac{1}{200}$  grain (0.0003 Gm) of scopolamine is given A hypodermic injection of  $\frac{1}{4}$  grain (0.016 Gm) of morphine sulfate is given immediately before the patient is taken to the operating room

Local Anesthesia A 1 per cent solution of procaine hydrochloride and 1 20,000 epinephrine hydrochloride is injected into the skin, fibrous

tissue and periosteum of the antauricular suprameatal membranous triangle. The same solution is injected into the skin, the fibrous tissue and the periosteum of the membranous portion of the posterior wall of the canal, which includes the outer third of this wall and extends from the anterior border of the concha inward as far as the osseous portion of the posterior wall.

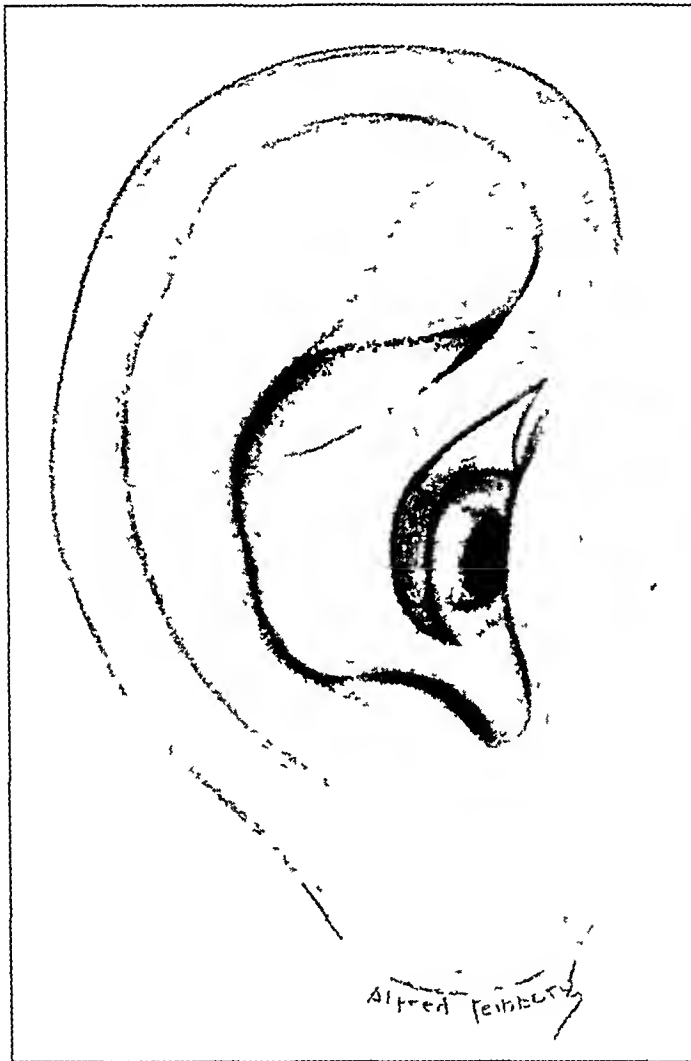


Fig 2—The creation of a mobile endaural membranous and extracartilaginous window for the antauricular surgical approach to the temporal bone, showing three endaural incisions.

The technic may be divided into the following surgical steps:

1. *The Creation of a Mobile Endaural Extracartilaginous Membranous Window for the Antauricular Surgical Approach to the Temporal Bone*—Three endaural incisions are made. The first is begun in the membranous lining of the superoposterior wall of the external auditory canal, at the junction of its osseous and membranous portions. This incision is carried downward and outward along the entire mem-



branous portion of the posterior wall of the canal until the lower end of the anterior border of the concha is reached. The second is begun at the point of commencement of the first incision in the superoposterior wall of the canal, is carried along and through the membranous lining of the outer third of the superoposterior wall and is continued upward adjacent to the tragus, into and along the anterior wall of the antauricular suprameatal membranous triangle and through the skin, the fibrous

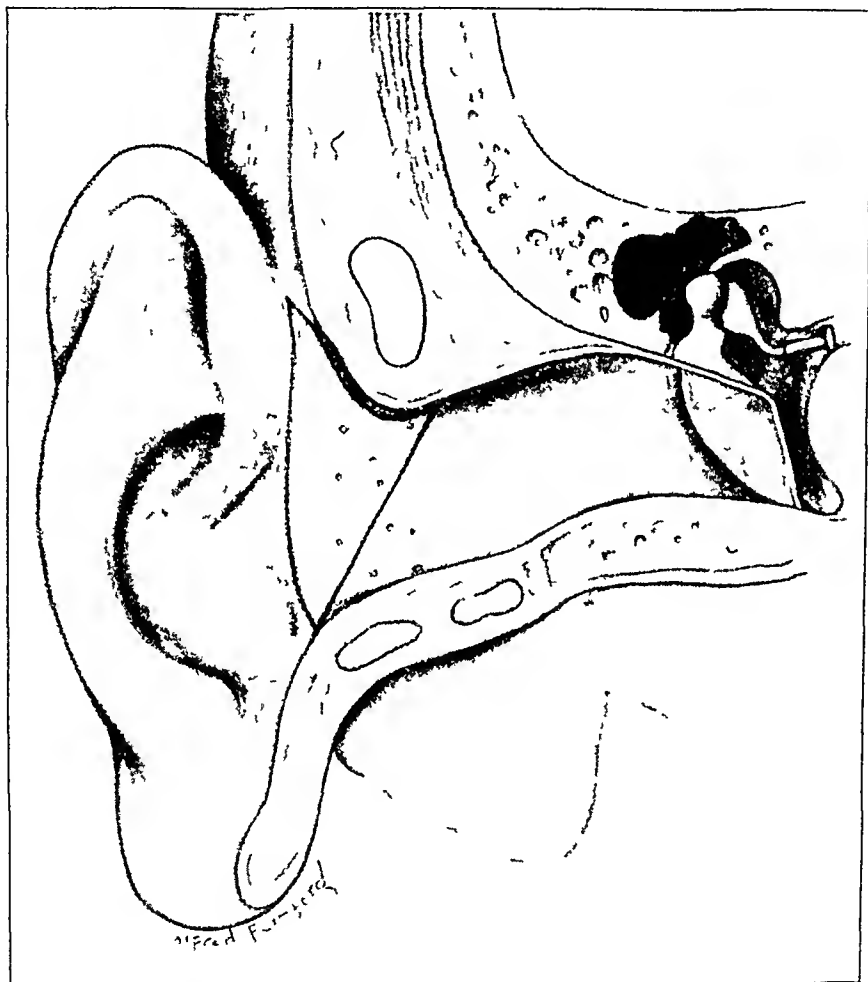


Fig 3—The creation of a mobile endaural membranous and extracartilaginous window for the antauricular surgical approach to the temporal bone, showing section view of the three endaural incisions (fig 2)

tissue and the periosteum up to the apex of this triangle. The third, which connects the first two incisions along the anterior border of the concha, is begun from the outer end of the first incision at the lower end of the anterior border of the concha, is carried upward through the skin, the fibrous tissue and the periosteum along the entire anterior border of the concha and continued along and adjacent to the anterior

border of the helix, which forms the posterior boundary of the antauricular suprameatal membranous triangle, up to the apex of the triangle where it meets the outer end of the second incision. These incisions are so designed that they remain extracartilaginous and extra-muscular.

The incisions should be carefully outlined at first by carrying them through the skin only, when the correct outline is successfully obtained,

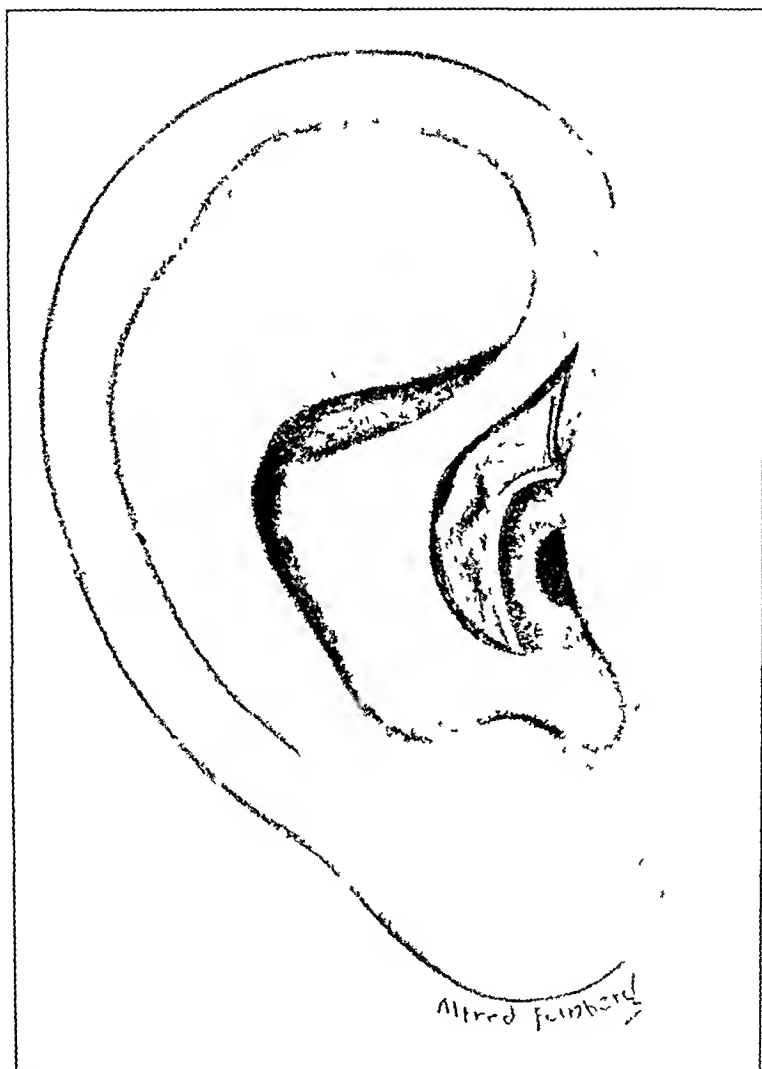


Fig 4—The creation of a mobile endaural membranous and extracartilaginous window for the antauricular surgical approach to the temporal bone. The endaural membranous flap has been removed, and the endaural membranous window can be seen.

they may then be carried deeper, through the rest of the membranous layers down to the bony surface of the temporal bone. The importance of making these incisions with the greatest accuracy and precision is twofold. 1. On these incisions depends the surgical accessibility of the temporal bone. 2. The incisions designate the extent of the cutaneous lining of the posterior and superior walls of the canal which is to be

left behind and later employed in the creation of the tympanomeatal membrane. A triangular flap of membranous tissue results from these three incisions.

A periosteal elevator is now inserted into the first incision, and while the underlying bony surface is hugged with the edge of the instrument, the entire triangular flap is subperiosteally lifted from its attachment to the bony surface. The upper and the lower end of this flap are then

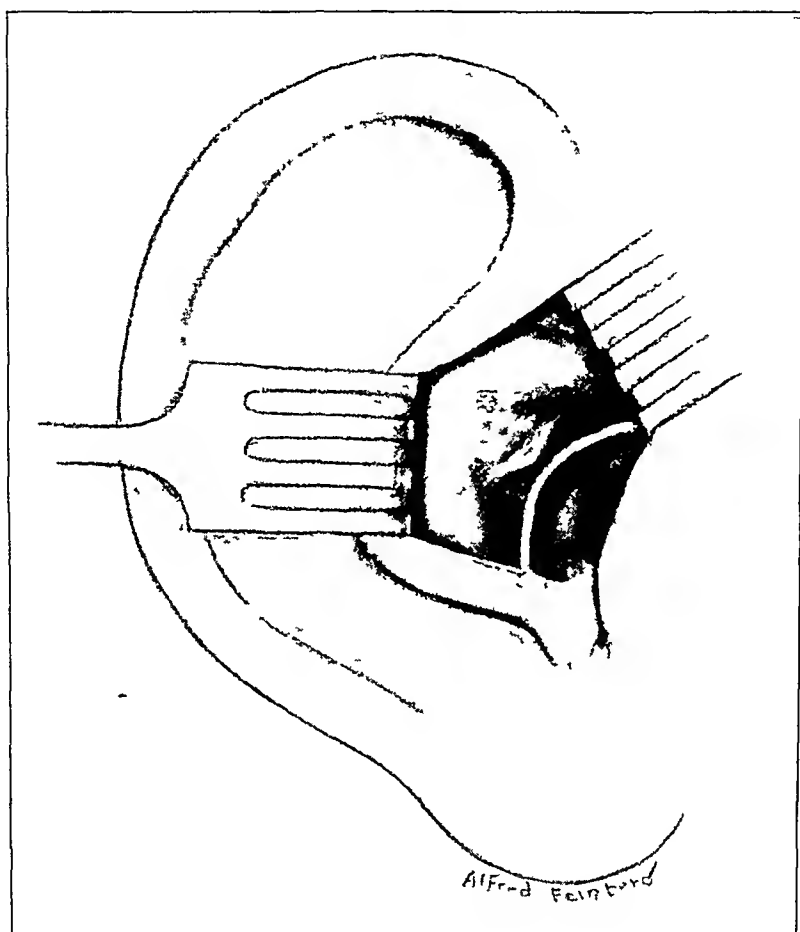


Fig 5—The creation of a mobile endaural membranous and extracartilaginous window for the antauricular surgical approach to the temporal bone, showing completion of the antauricular exposure of the mastoid process

freed from their final attachments with the aid of curved scissors. This triangular flap, which consists of the outer third of the membranous lining of the posterior and the superoposterior wall of the canal and contains hair follicles and ceruminous glands, is removed and discarded. The removal of this membranous flap results in an endaural extracartilaginous membranous window for the antauricular surgical approach to the temporal bone. This endaural membranous window is now

mobilized by a subperiosteal elevation of both the postauricular skin and periosteum covering the outer mastoid cortex and the antauricular skin and periosteum covering the posterior root of the zygoma. Two retractors are inserted and held in position by an assistant.

With the retractors in situ, the endaural membranous window can be moved in any desired direction over the temporal bone to permit the necessary surgical intervention. The first endaural exposure of the temporal bone obtained with this described technic reveals the outer mastoid cortex with Macewen's area, the spine of Henle, the outer border of the anterior mastoid cortex and the posterior root of the zygoma.

*2 The Exposure and Sharp Definition of the Horizontal External Semicircular Canal*—The cutaneous lining covering the osseous portion of the posterior wall of the external auditory canal is subperiosteally elevated with a specially devised narrow subperiosteal elevator for a distance of about 5 mm, in order to expose the superoposterior bony wall of the canal. With an electrically driven serrated dental burr the antium is entered through the superoposterior wall, the burr being directed posteriorly and inward. With the same burr an area of mastoid cortex is removed from the superoposterior wall and from the outer mastoid cortex over Macewen's triangle, and a larger point of entrance and greater accessibility to the mastoid antrum are thus created.

With an electrically driven no. 3 round burr more of the outer cortex is removed. The cellular structure immediately underlying this cortex and surrounding the mastoid antrum is removed with a no. 1 curet. The roof of the mastoid antrum is quickly located, and the cellular structure adjacent to it is removed until the smooth inner bony table covering the middle fossa dura in the region of the mastoid antrum is exposed to view. The outer cortex of the posterior root of the zygoma is removed with a no. 3 round burr. The zygomatic cells overhanging the entrance from the antium to the aditus are removed with a no. 0 curet. With the same curet the floor of the antrum is scraped, and all the basal perilabyrinthine cells encountered are removed until the solid ebonized base of the basal labyrinthine portion of the petrous pyramid is exposed to view. The antral posterior end of the floor of the aditus is curetted, and the external semicircular canal, which forms the threshold between the antrum and the aditus, is exposed to view. The contour of the horizontal external semicircular canal is sharply defined by removal of all the cellular structure immediately surrounding it. The sharp definition of the external semicircular canal is complete when its convexity appears elevated and projects prominently from the floor of the aditus and antium with its anterior and posterior borders freed from surrounding cellular structure.

3 *Plastic Construction of the Cutaneous Tympanomeatal Membrane*—The tympanomeatal cutaneous membrane is a one piece membrane consisting of a meatal and a tympanic portion. The meatal portion consists of the thin cutaneous lining freed from its attachment to the posteroinferior, the posterior, the superoposterior, the superior and the anterosuperior bony wall of the external auditory canal. The tympanic portion consists of the tympanic membrane, the posterior the supero-

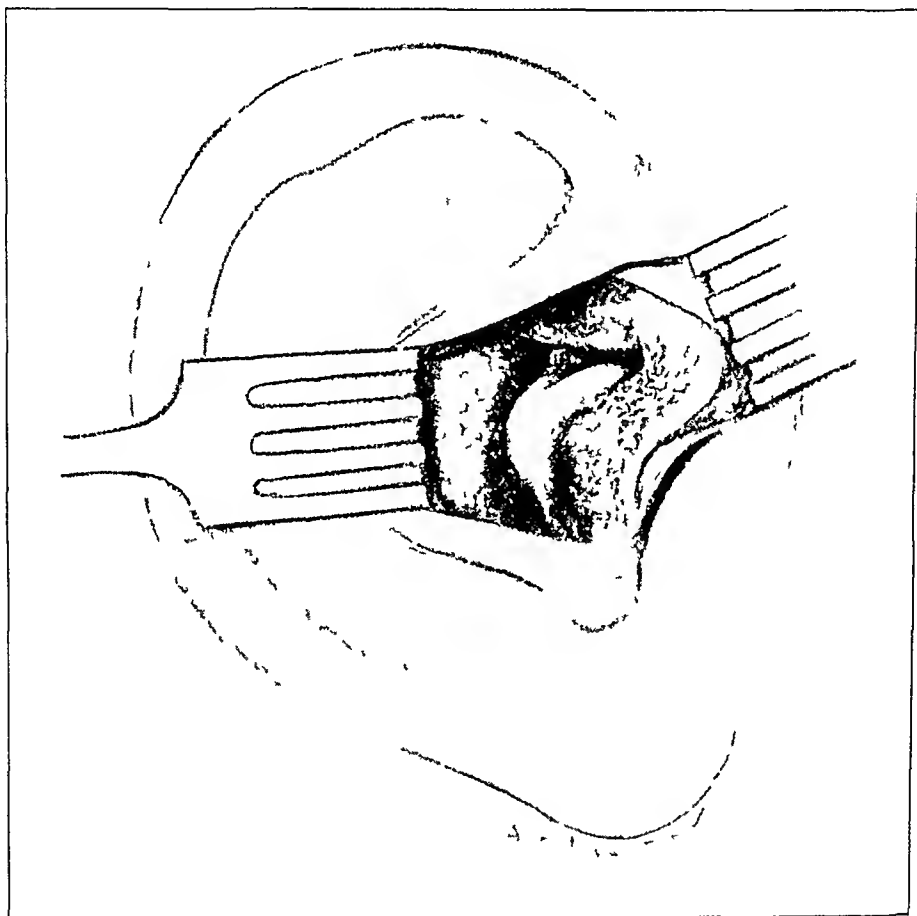


Fig 6—Exposure and sharp definition of the external semicircular canal

posterior, the superior and the anterosuperior margin of whose circumference were freed from the sulcus tympanicus and whose fibrocartilaginous ring was left attached only to the remaining anterior and inferior walls of the sulcus tympanicus. The tympanic and meatal portions of the tympanomeatal cutaneous membrane are joined and held together by the delicate cuticular outermost layer of the tympanic membrane, which extends from and is a part of the cutaneous lining of the bony canal wall which forms the meatal portion of the membrane.

The cutaneous lining, which forms the meatal portion of the tympanomeatal membrane and unites this portion with the tympanic portion by extending to form the delicate outer cutaneous layer of the tympanic membrane, is very thin. In its extent outward from the margin of the membrana tympani for a distance of about 10 mm the thickness of the meatal portion varies from 0.01 to 0.03 mm. The tympanomeatal membrane, when completed, is the thinnest cutaneous membrane that could possibly be obtained plastically or grown biologically. It is

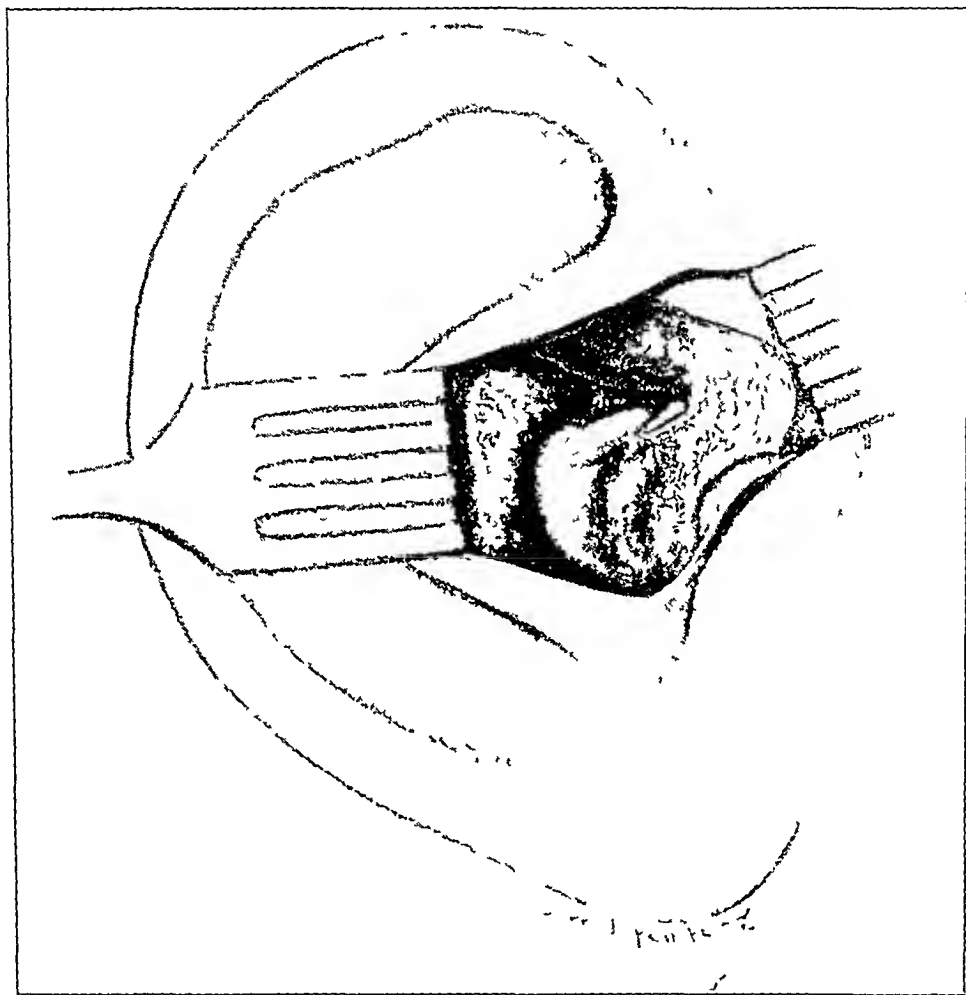


Fig 7—The plastic construction of the tympanomeatal cutaneous membrane, showing skeletonization of the posterior and the superoposterior bony wall of the external auditory canal, which results in the exposure of the body of the malleus

destined to seal the perilymph space through the window which is to be created in the bony capsule of the external semicircular canal.

To obtain this cutaneous tympanomeatal membrane completely intact, without injury, without severing of the meatal portion from its attachment to the tympanic portion and without perforation of the tympanic membrane is a surgical task that requires great finesse. Experience has shown the safest method of freeing these membranes, united and

intact, from the bony structure to which they are attached to be first to skeletonize and then to resect the bony structures away from these membranes, instead of attempting to lift these membranes away from the bony structure

The plastic construction of the cutaneous tympanomeatal membrane may be accomplished best and without undue surgical risk by the following surgical technic

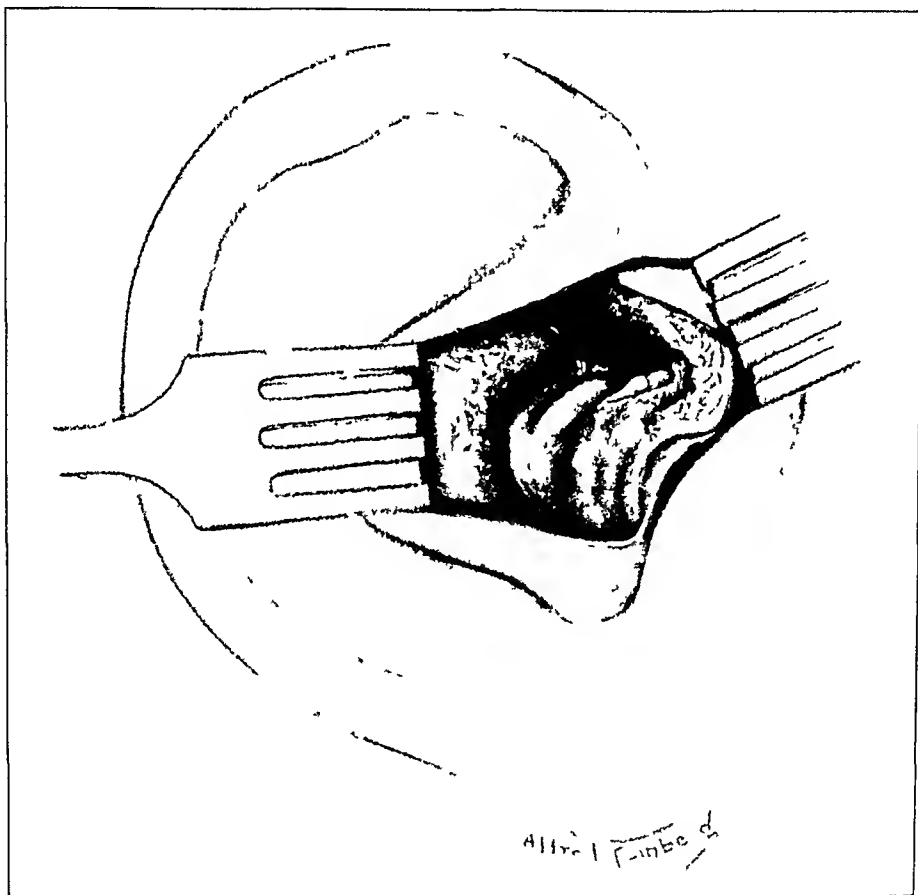


Fig 8—The plastic construction of the tympanomeatal cutaneous membrane, showing skeletonization of the superior bony wall of the external auditory canal, which results in an exposure of the incudomalleolar joint

(a) *Skeletonization of the Posterior and the Superoposterior Bony Wall of the Canal* With a no 00 mastoid curet all the cells lying adjacent to and covering the posterior surface of the mastoid portion of the posterior bony wall of the canal are removed until a smooth bony surface free from cells is obtained. The cells lying adjacent to the posterior surface of the tympanic portion of the posterior wall are removed to the level of the bony capsule of the vertical portion of the facial nerve. The prominence of the external semicircular canal is

employed as a guide in tracing the anatomic position of the vertical portion of the fallopian canal. The outer cortex of the remains of the posterior root of the zygoma is removed further anteriorly and the zygomatic cells lying adjacent to and covering the squamous portion of the superoposterior bony wall of the canal are removed until a smooth continuity of bony surface with that of the smoothened posterior surface of the mastoid portion of the posterior wall is obtained. As a result of this step in the surgical technic the posterior aspect of the incus,

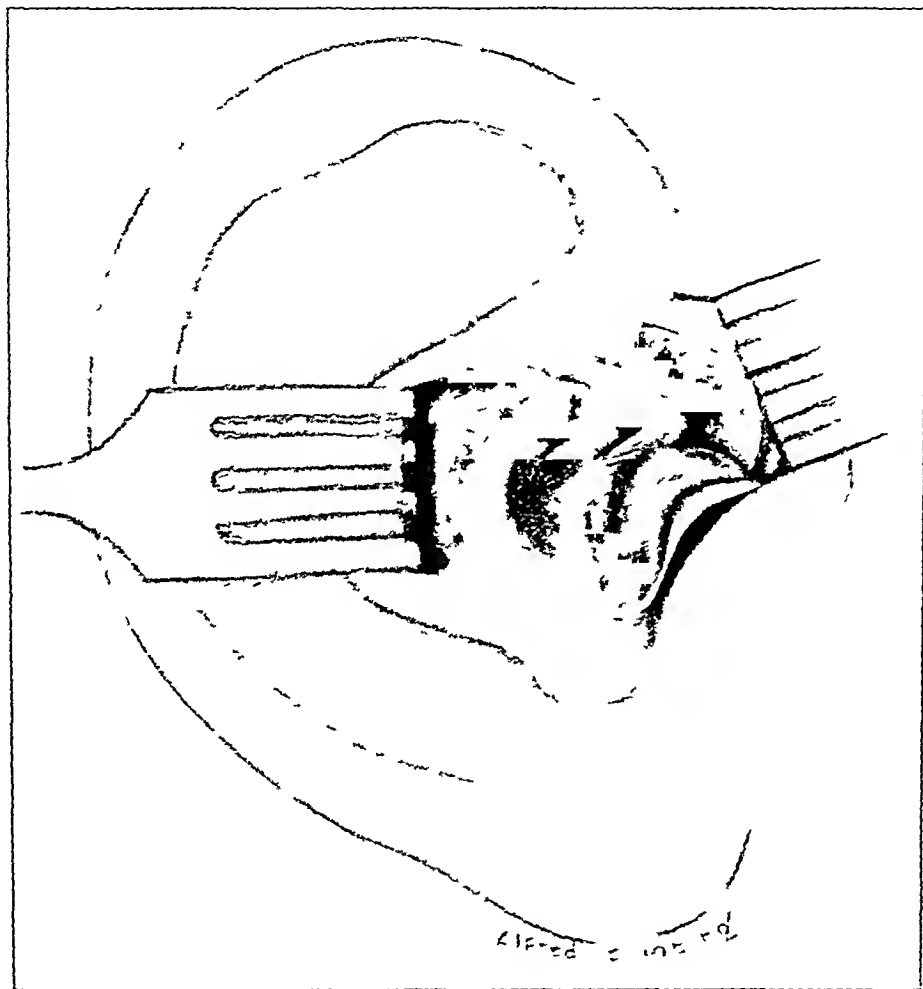


Fig 9—The plastic construction of the tympanomeatal cutaneous membrane, showing skeletonization of the anterosuperior bony wall of the external auditory canal, which results in an exposure of the entire epitympanic recess

occupying a position almost parallel to and anterior and adjacent to the horizontal course of the prominence of the external semicircular canal, is brought into view

(b) *Skeletonization of the Superior Bony Wall of the External Auditory Canal* With a no 2 round burr the outer cortex of the posterior root of the zygoma is removed farther anteriorly to expose the zygomatic cellular structure lying anterior and external to the incus



and adjacent to the upper surface of the squamous portion of the superior bony wall of the external auditory canal. With a no. 00 curet this cellular structure is completely removed, the operator working in a direction anterior to the already smooth and skeletonized superoposterior bony wall of the canal. Curetting gradually progresses from without inward, the entire upper surface of the superior bony wall of the canal up to the sulcus tympanicus being skeletonized until a smooth-

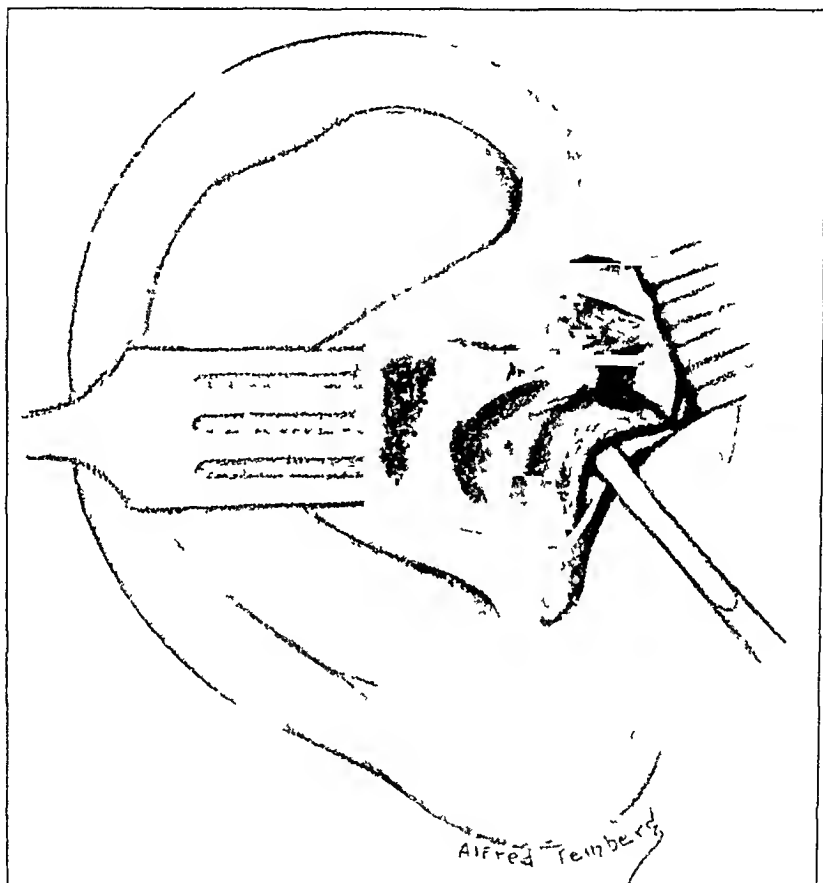


Fig 10—The plastic construction of the tympanomeatal cutaneous membrane, showing subperiosteal elevation of the cutaneous lining covering the posterior, the superoposterior, the superior and the anterosuperior bony wall of the canal (1 mm at a time)

ened continuity with the superoposterior wall is obtained. As a result of this step in the surgical technic, the entire incudomalleolar joint in its position within the epitympanic recess is exposed to view.

(c) *Skeletonization of the Anterosuperior Bony Wall of the External Auditory Canal.* With the curet directed anterior to the head of the malleus and curetting being done from without inward, the upper surface of the curvature of the squamous portion of the anterosuperior

bony wall of the canal is smoothened and skeletonized up to the sulcus tympanicus. As a result of this surgical maneuver, the entire epitympanic recess is brought into view.

(d) Resection of the Skeletonized Posterior, Superoposterior, Superior and Anterosuperior Bony Walls of the Canal from Without Inward up to the Sulcus Tympanicus. A specially devised narrow periosteal elevator is inserted between the cutaneous lining and the skeletonized posterior and superoposterior bony walls of the canal, and the cutaneous

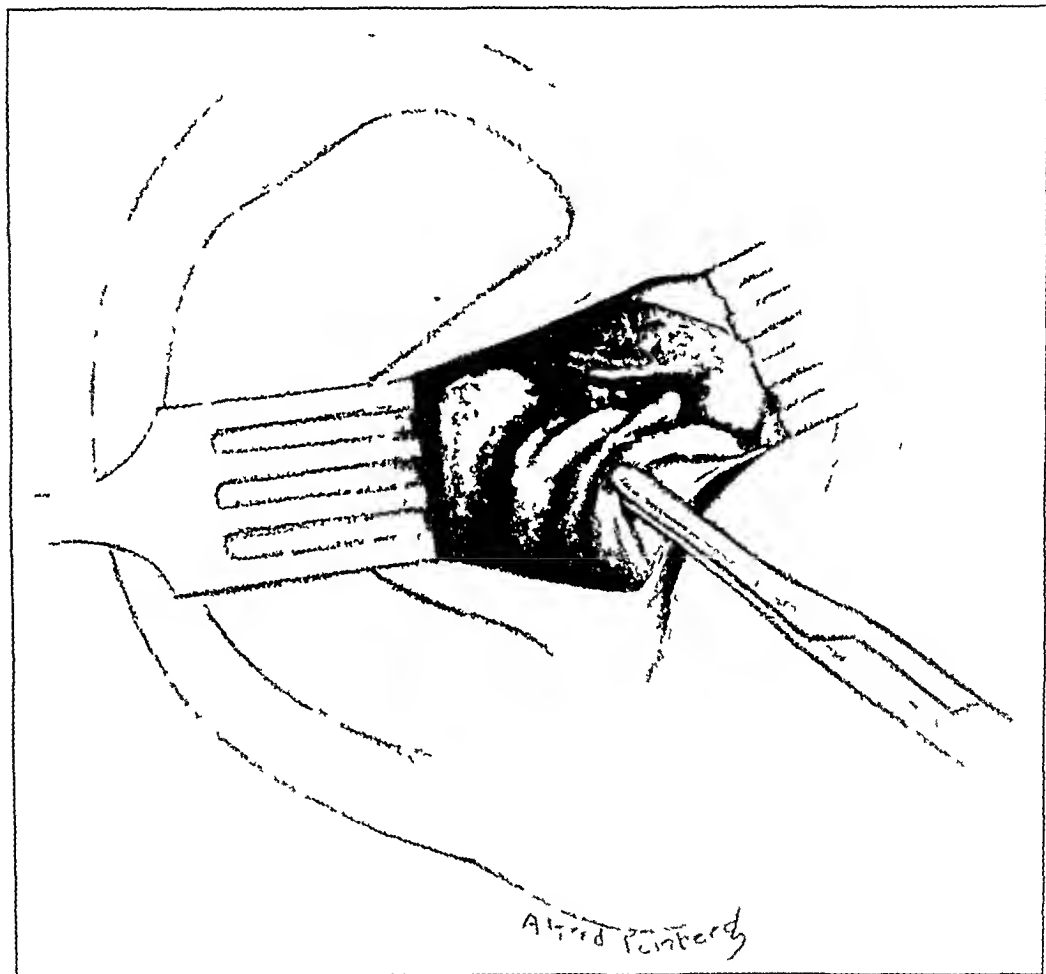


Fig. 11—The plastic construction of the tympanomeatal cutaneous membrane, showing removal of the skeletonized posterior and superoposterior bony walls of the canal down to the level of the bony capsule surrounding the vertical portion of the facial nerve and the removal of the superior and the anterosuperior skeletonized bony wall down to the level of the sulcus tympanicus.

lining is gently separated from its attachment to the bony surface, 1 mm at a time. Each millimeter of bony wall thus exposed is successively removed with a specially devised rongeur, up to the level of the bony capsule of the vertical portion of the facial nerve. The skeletonized superior and anterosuperior walls are removed up to the sulcus tym-

panicus by the same technic. This step in the technic must be accomplished without injury to the cutaneous lining of the bony canal.

(e) *Skeletonization and Resection of the Sulcus Tympanicus* This is necessary in order to free the posterior, the superoposterior, the superior and the anterosuperior margin of the circumference of the tympanic portion of the tympanomeatal cutaneous membrane.

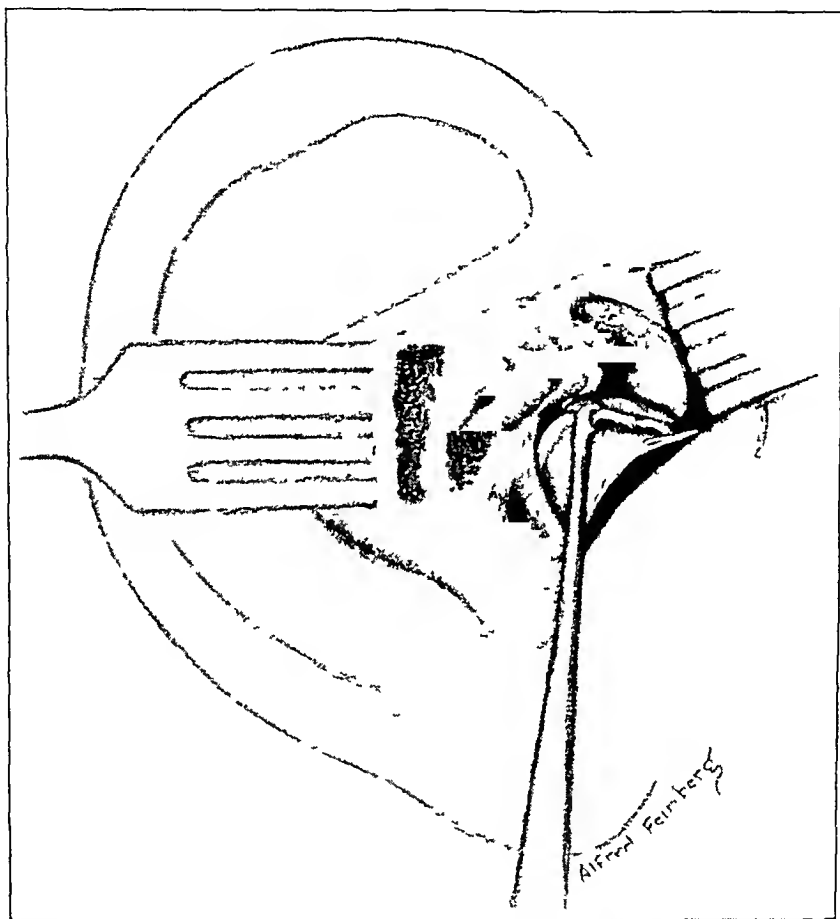


Fig 12—The plastic construction of the tympanomeatal cutaneous membrane, showing the skeletonization and removal of the sulcus tympanicus from the posterior, the superoposterior, the superior and the anterosuperior margin of the circumference of the tympanic membrane.

The portions of the sulcus tympanicus on either side of the notch of Rivinus, within which the posterior, the superoposterior, the superior and the anterosuperior margin of the circumference of the tympanic membrane are framed, are slowly and cautiously shaved away from the fibrocartilaginous ring of the tympanic membrane with a no. 000 mastoid curet. By slow shaving from below upward and then forward as far as the posterior edge of the notch of Rivinus, minute, extremely thin

portions of bone are removed from the posterior surface of the posterior and the superoposterior wall of the sulcus tympanicus. This shaving is continued until the sulcus tympanicus is skeletonized and becomes papyraceous when it spontaneously fractures. It is then lifted in minute pieces away from the fibrocartilaginous ring of the tympanic membrane. As a result of this step in the technic, the posterior and the supero-

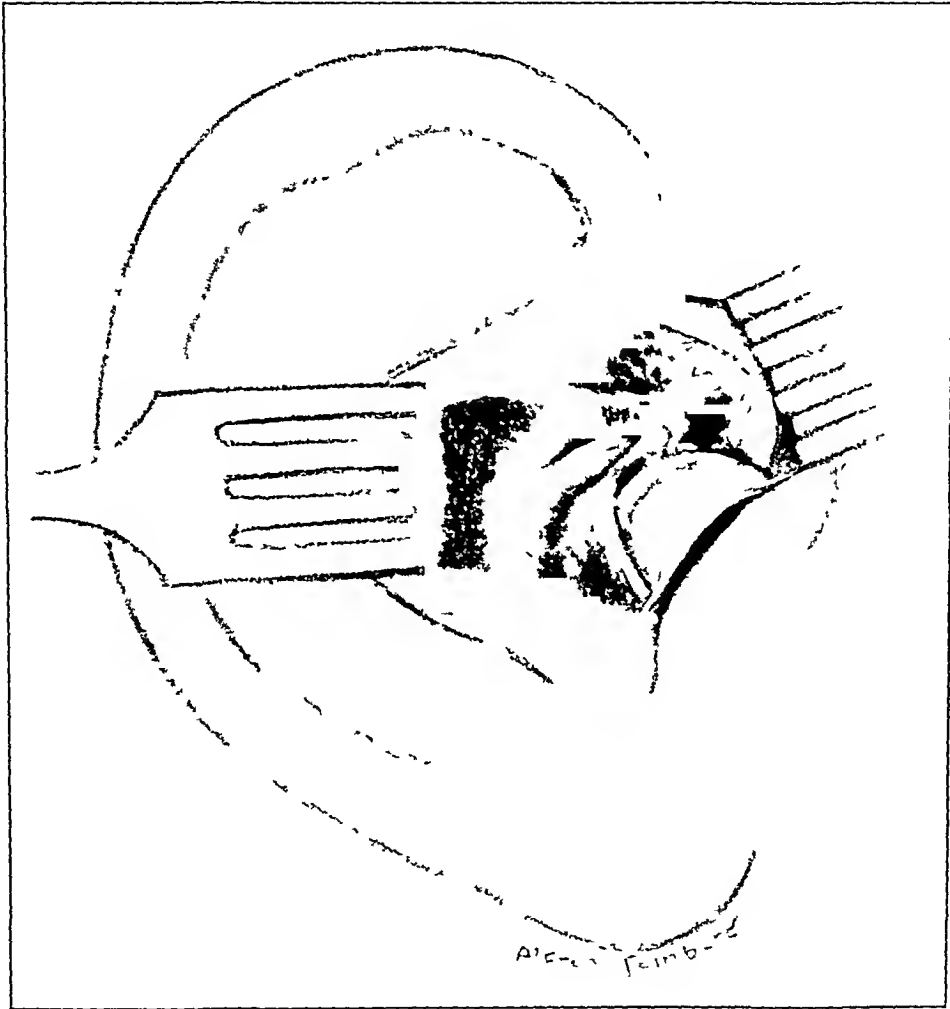


Fig 13—The plastic construction of the tympanomeatal cutaneous membrane after removal of the sulcus tympanicus, showing the long crus of the incus, the neck of the malleus and the tendon of the tensor tympani muscle attached to the neck of the malleus

posterior margin of the fibrocartilaginous ring of the tympanic membrane are freed, and the long process of the incus is exposed to view.

The upper surface of the innermost margin of the superior bony wall of the canal which corresponds to the notch of Rivinus is gently skeletonized and removed from its cutaneous lining, which is continuous with Shrapnell's membrane, and the posterior and the anterior malleolar fold of the membrana tympani, which extend from the short process

of the malleus. This results in the freeing of Shrapnell's membrane and the exposure of the neck of the malleus.

The upper surface of the anterosuperior wall of the sulcus tympanicus, anterior to the anterior edge of the notch of Rivinus, is skeletonized by removal of minute shavings of bone until the sulcus tympanicus becomes papyraceous and fractures spontaneously. It is then lifted away piecemeal from the anterosuperior margin of the fibrocartilaginous ring of the tympanic membrane. After this part of the circumference

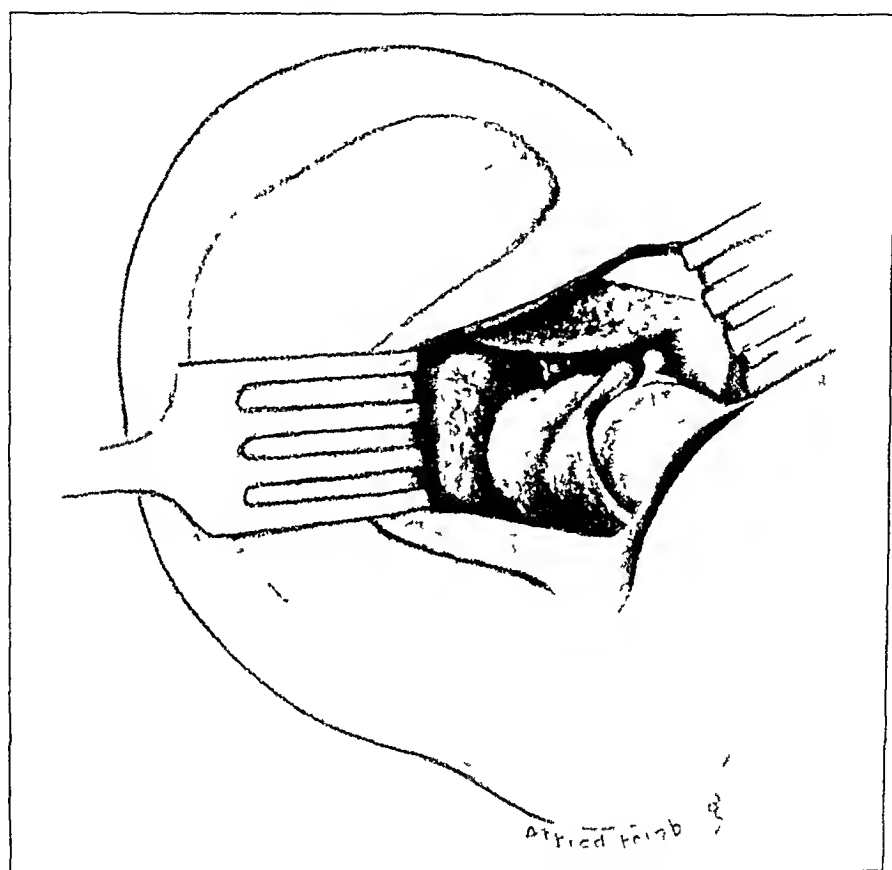


Fig 14—The liberation of the tympanic membrane from its anchorage to the ossicular chain, showing separation of the head of the malleus from the incus without disturbance to the position of the incus.

of the tympanic membrane has been freed, the tendon of the tensor tympani muscle, inserted into a slight projection near the upper end of the medial side of the manubrium mallei, is seen.

The resection of the amount of bony structure necessary for the creation of the cutaneous tympanomeatal membrane is now complete. There should be a continuous, completely intact, nonperforated tympanomeatal cutaneous membrane, whose tympanic portion is attached only to the remaining anterior and inferior walls of the sulcus tympanicus.

and whose meatal part is left temporarily attached to the remaining inferior and anterior bony walls of the external auditory canal

4 *Liberation of the Membrana Tympani from Its Anchorage to the Ossicular Chain*—In order to permit the excision of the tympanic portion of the tympanomeatal cutaneous membrane beyond and superoposterior to the tympanic cavity, the membrana tympani must be freed from its anchorage to the ossicular chain

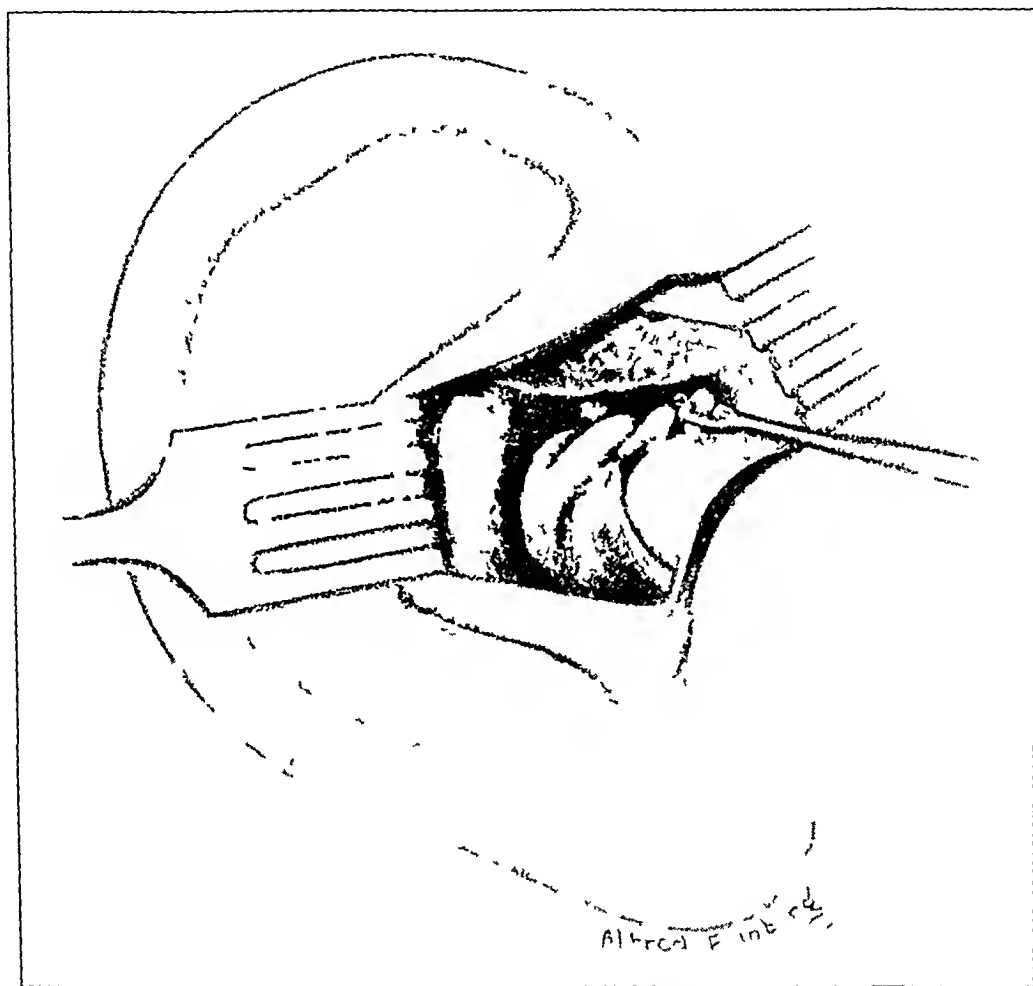


Fig 15—The liberation of the tympanic membrane from its anchorage to the ossicular chain, showing amputation with a specially devised guillotine of the head of the malleus at its point of junction with the neck of the malleus

This is accomplished by resecting the head of the malleus. The incudomalleolar joint must be opened first, in order to resect the head of the malleus without disturbing the position of the incus. With a specially devised sharply pointed knife, the articular capsule which surrounds the incudomalleolar joint is gently incised and lifted to expose the articular cavity. The incudomalleolar joint is next divided, by introduction of the knife into the joint between the facets of the malleus and the incus and cautious working of the knife inward until the inner wall of the epitympanic recess is reached. By gentle moving of the

knife from above downward until the neck of the malleus is reached, the two facets are separated. Great caution must be exercised that the incus is not jolted, to insure against disturbing the incudostapedial joint. The superior ligament of the malleus, which descends from the roof of the epitympanic recess to the head of the malleus, is severed with the same knife. The lateral ligament of the malleus, which binds the head of the malleus to the posterior part of the notch of Rivinus,

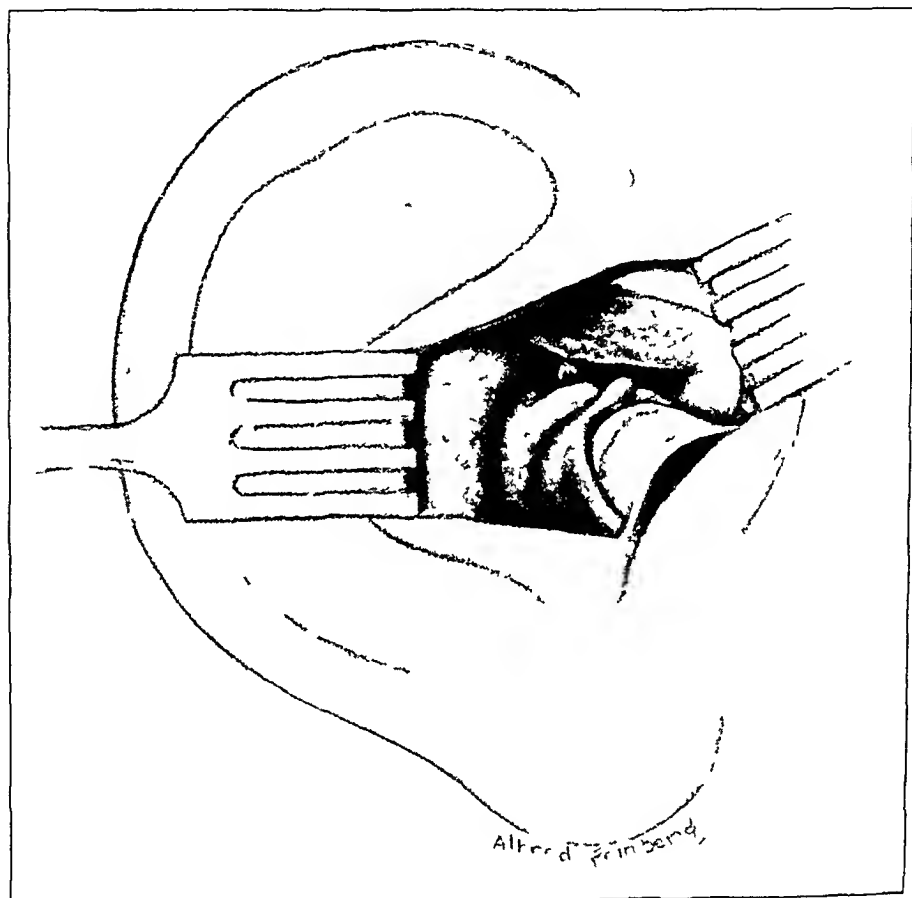


FIG 16—The liberation of the tympanic membrane from its anchorage to the ossicular chain after amputation and removal of the head of the malleus

is severed, and the head of the malleus is gently pushed and displaced for a distance of 1 or 2 mm in a direction anterior to the incus.

The malleus is engaged immediately below the head and at the beginning of its neck with a specially devised guillotine. The guillotine is held in one hand and steadied with the other, and the head of the malleus is amputated and removed. Great caution must be exercised in this part of the technic, because the slightest traction or jolting of the head of the malleus may result in a contracoup penetration and perforation of the tympanic membrane by the manubrium mallei.

The amputation and removal of the head of the malleus will serve later to permit the hermetic closure of the tympanic cavity and the exclusion of the epitympanic recess from the newly created auditory mechanism

5 *Decompression of the Dura of the Temporal Lobe in the Region of the Epitympanic Recess*—The inner bony table, which forms the roof of the epitympanic recess and is part of the floor of the middle fossa first is skeletonized with a no 2 round burr. When it becomes

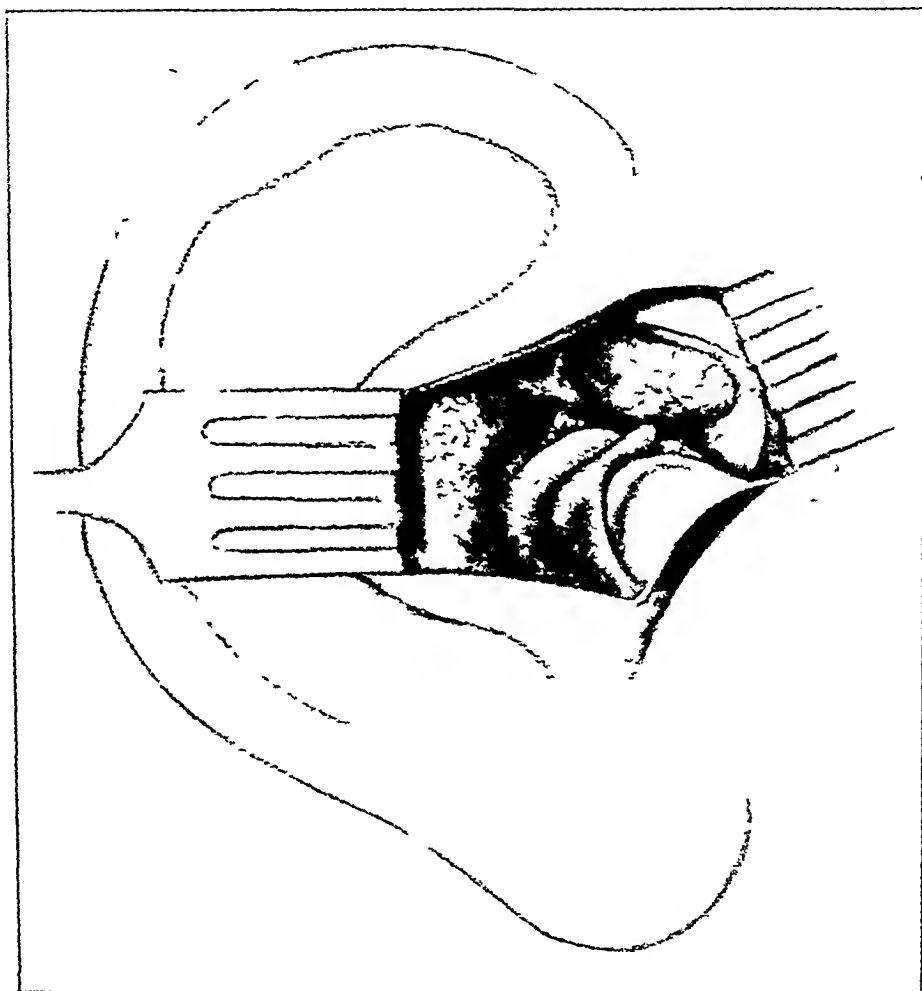


Fig 17—The decompression of the dura of the temporal lobe in the region of the epitympanic recess. The dural plate in the region of the epitympanic recess has been skeletonized, fractured and lifted away from the dura.

papyraceous it is fractured and lifted away from the dura of the temporal lobe with a no 1 curet. The temporal lobe is thus decompressed in the region of the tympanic cavity. The object of this surgical step is to relieve the perilyabyrinthine venous stasis which has been suggested by Wittmaack<sup>8</sup> to be the cause of the pathogenesis in otosclerosis.

<sup>8</sup> Wittmaack, K. Die Ursache der Otosklerose. Ein Vorschlag zur ursächlichen Behandlung. Arch f Ohren-, Nasen- u Kehlkopfh 129 150 (June 26) 1931.



6 *The Excavation of a Troughlike Fenestra in the Bony Capsule of the External Horizontal Semicircular Canal, Down to the Perilymph Space*—The troughlike fenestration of the external semicircular canal is an especially devised surgical means of mechanically preventing the eventual closure of the fenestra by regeneration of bone, which has defeated all former surgical efforts for the improvement of hearing

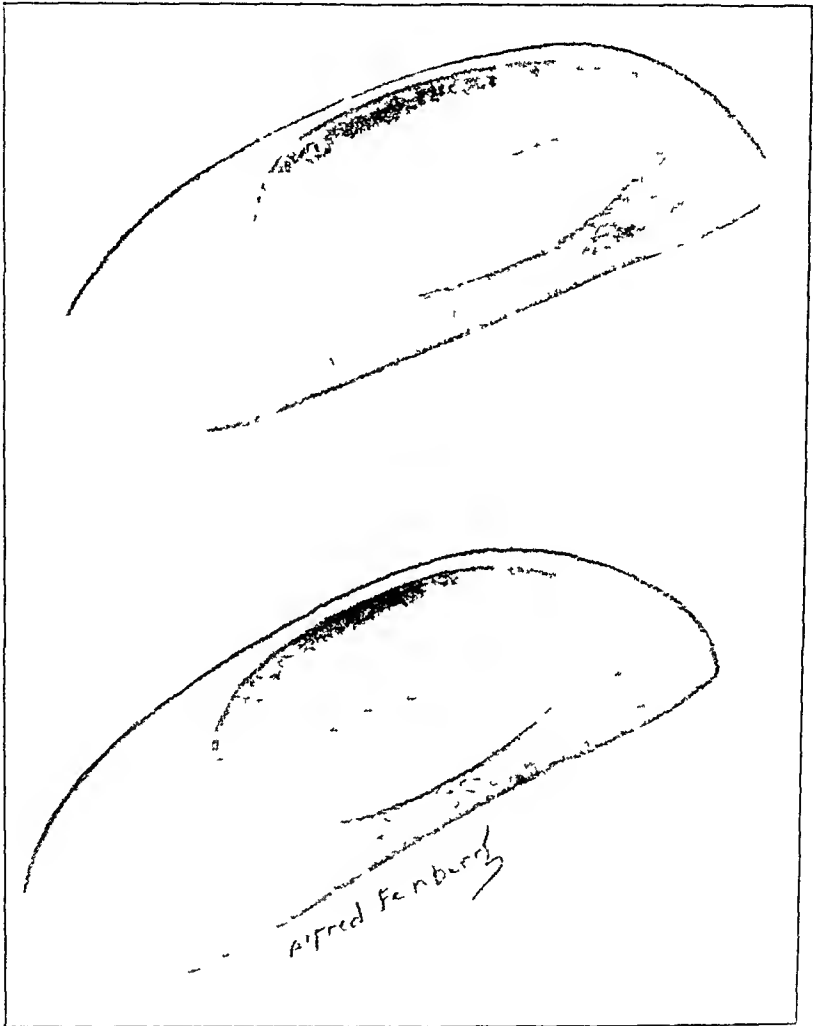


Fig 18—The excavation (stages 1 and 2) of a troughlike fenestra in the bony capsule of the external semicircular canal for the permanent mobilization of the labyrinthine perilymph, showing the excavated trough with its surrounding bony walls and skeletonized transparent bony floor, through which the lumen of the canal may be visualized

This part of the surgical technic requires most delicate instrumentation and manipulation. It must be done carefully and slowly, under brilliant illumination and with the aid of extremely powerful magnify-

ing glasses It must be accomplished without injury to the membranous labyrinth

An electrically driven no 2 round dental finishing or polishing burr, the width of whose circumference is about one-half that of the outer surface of the bony capsule of the external semicircular canal, is

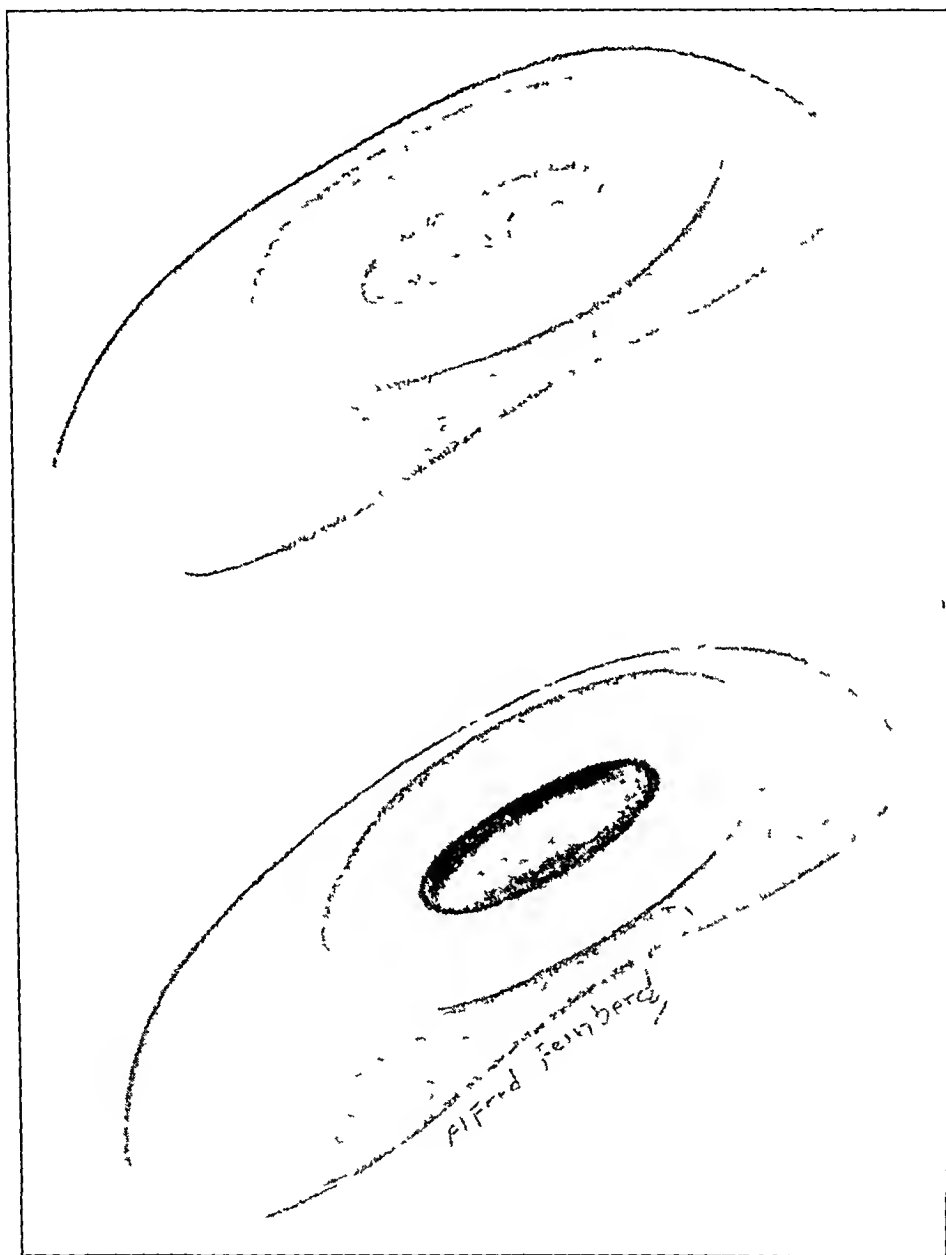


Fig 19—The excavation (stages 3 and 4) of a troughlike fenestra in the bony capsule of the external semicircular canal for the permanent mobilization of the labyrinthine perilymph The upper drawing shows the excavated trough with its skeletonized transparent bony floor removed down to its endosteum, through this the membranous labyrinth can be visualized The lower drawing shows the excavated trough with its endosteal floor removed and the perilymph space and the membranous labyrinth exposed

employed for the excavation of the trough. The burr must be held in perfect control, and its excursions must be light and most carefully guided. The troughlike excavation should be begun on the outer surface of the bony capsule of the external semicircular canal, immediately below the ampulla, and should be extended for about 3 mm along the longitudinal axis of the capsule and limited to the center of the width of the canal.

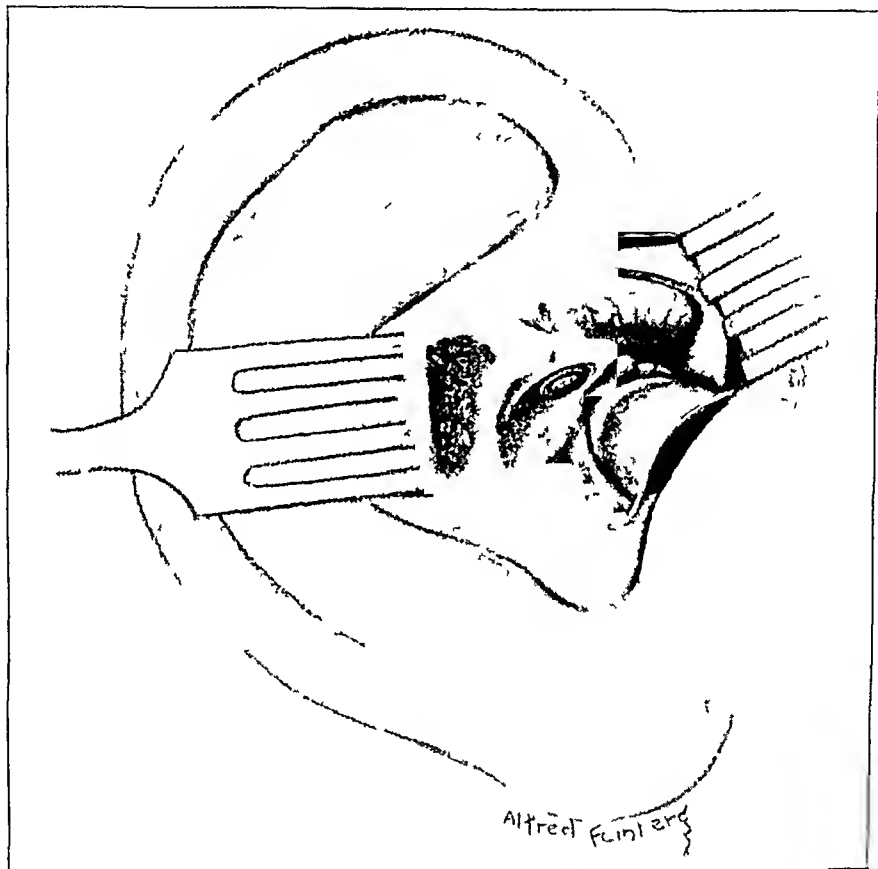


Fig. 20—Completion of the excavation of a troughlike fenestra in the bony capsule of the external semicircular canal for the permanent mobilization of the labyrinthine perilymph.

This troughlike fenestra is created by several surgical stages:

1. Excavation of a troughlike groove with all its surrounding walls converging toward the bottom to meet its floor, which assumes the form of an extremely thin and transparent innermost periosteal layer of bone. Through this transparent floor the lumen of the external semicircular canal can be visualized in the form of a bluish gray line (under strong illumination and magnification).

2 Widening of the thin transparent bony floor at the bottom of the trough to permit visualization of the entire width of the lumen of the semicircular canal

3 Careful polishing down of the bony floor of the trough, to remove the extremely thinned-out innermost periosteal layer of the bony capsule and the endochondral layer down to the endosteum. Though this extremely transparent endosteal floor the membranous labyrinth can now be visualized within the perilymph space in the lumen of the semicircular canal

4 Gentle pulverizing of the extremely delicate endosteum, which forms the floor of the troughlike fenestra, with a few strokes of the polishing burr, until one or several microscopic drops of perilymph appear through the pores in the pulverized endosteum

With the appearance of the first microscopic drop of perilymph, the patient complains of severe vertigo, and almost immediately a tremendous improvement in hearing manifests itself

The lateral margins of the pulverized endosteal floor which cover the widest part of the perilymph space are now carefully removed with the lightest excursions of the burr. This results in an exposure of the widest portion of the perilymph space. With strong illumination and magnification, the intact membranous labyrinth, surrounded by pulsating perilymph, can now be seen

When completed, the troughlike fenestra within the bony capsule of the external semicircular canal has slightly sloping bony walls extending from the wider aperture on the roof of the bony capsule to the narrower aperture in its floor, which communicates with the perilymph space. The walls surrounding this fenestra must maintain the original thickness of the bony capsule

#### 7 *Final Liberation of the Tympanomeatal Cutaneous Membrane* —

The meatal portion of the tympanomeatal cutaneous membrane, which was left attached temporarily to the inferior and anterior bony walls of the external auditory canal to protect it from accidental injury, is detached. An incision is made through the cutaneous lining of the anterior bony wall of the canal, beginning at the point of attachment of the tympanic membrane to the remaining superoanterior end of the sulcus tympanicus, and is carried outward and slightly downward along the entire superoanterior bony wall of the canal to its outermost margin. Another incision is made through the cutaneous lining of the postero-inferior bony wall of the canal, beginning at the point of attachment of the tympanic membrane to the remaining inferoposterior end of the sulcus tympanicus, and is carried outward and inclined somewhat downward along the entire posteroinferior bony wall of the canal to its outermost margin. A fine narrow periosteal elevator is inserted into

these incisions, and the still attached borders of the meatal portion of the tympanomeatal membrane are elevated from the underlying bony surfaces. This results in a complete severance of the meatal portion of the tympanomeatal membrane from its bony attachments, and there is completed a plastically constructed one piece tympanomeatal cutaneous membrane, attached only anteriorly and inferiorly to the anterior and the inferior wall of the sulcus tympanicus. This membrane is vascularized by the blood vessels of the membrana tympani.

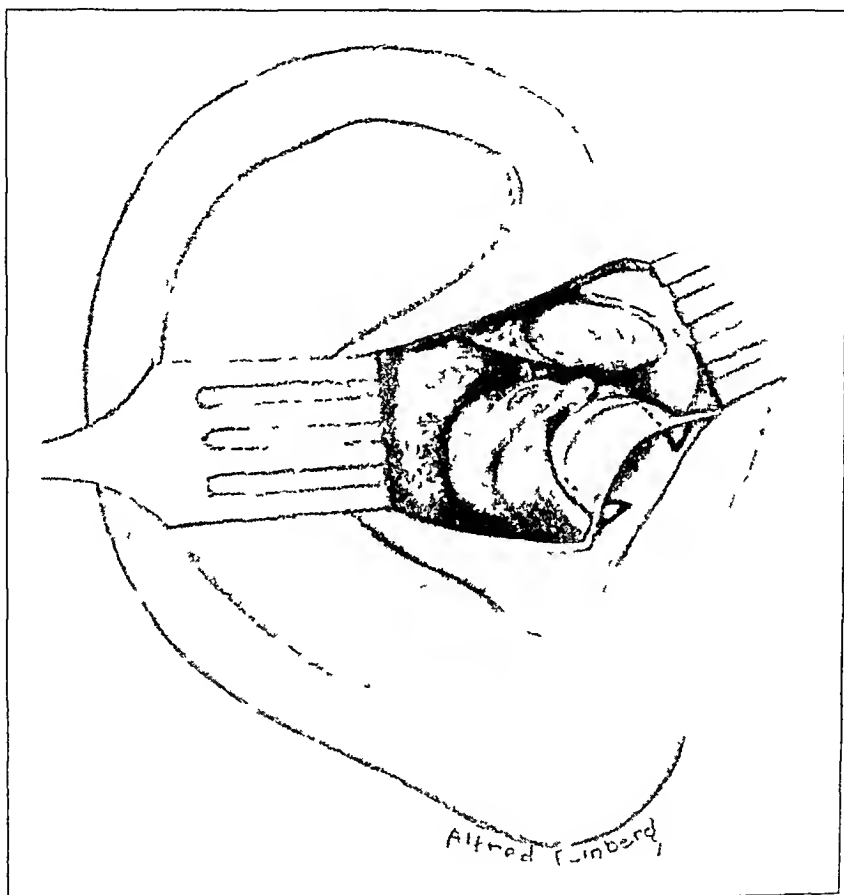


Fig 21—The final liberation of the meatal portion of the tympanomeatal cutaneous membrane from its attachments to the superoanterior and the postero-inferior bony wall of the external auditory canal

*8 The Placement and Molding of the Tympanomeatal Cutaneous Membrane*—The tympanomeatal cutaneous membrane, whose tympanic portion can now be made to extend superoposterior to the tympanic cavity, is gently stretched and placed so that the membrana tensa seals the tympanic cavity and covers the incus and the membrana flaccida covers the fenestra in the external semicircular canal. The remaining meatal portion of the tympanomeatal membrane covers the inner wall

of the epitympanic recess and the mastoid aspect of the basal labyrinthine portion of the petrous pyramid

9 *Insertion of the Tympanomeatal Cutaneous Membrane into the Troughlike Fenestra of the External Semicircular Canal*—A piece of paraffin mesh rolled into a small ball is placed over the portion of the tympanomeatal membrane which covers the outer aperture of the troughlike fenestra in the external semicircular canal. After gentle

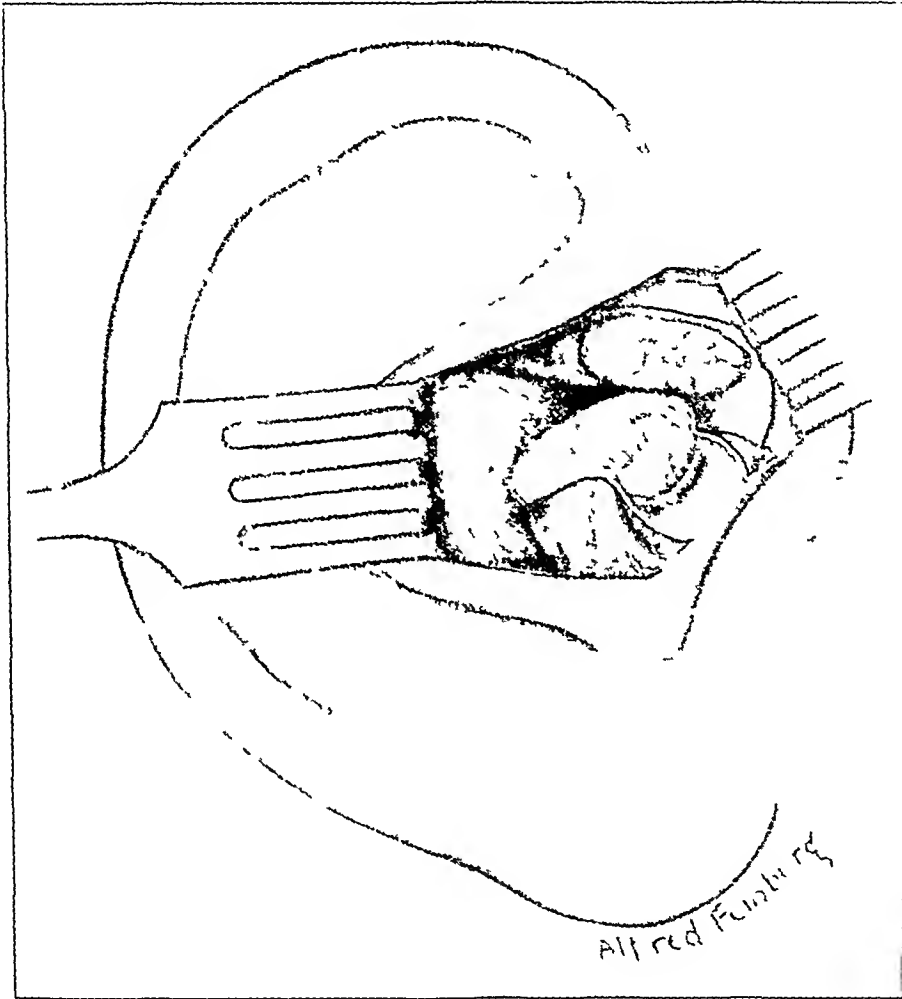


Fig 22—The completely intact tympanomeatal cutaneous membrane placed in position. This membrane, properly placed, seals the tympanic cavity, covers the incus, is inserted into the troughlike fenestra, lines the inner surface of its bony walls, covers the floor of the trough, seals the perilymph space and lies in direct contact with the perilymph.

pressing and molding of the paraffin mesh over Shrapnell's membrane the latter is inserted into the troughlike fenestra so as to line the inner surface of its walls, extend immediately beyond the edge of the inner aperture of the fenestra and lie in direct contact with the perilymph. The paraffin mesh ball is held in place by additional pieces of paraffin mesh inserted into the mastoid wound. On the care and precision

with which this step in the technic is carried out depends the permanent maintenance of the fenestra in the bony capsule. The insertion of Shrapnell's membrane into the troughlike fenestra in the manner described is another step in the mechanical prevention of closure of the fenestra by regeneration of bone.

A mastoid dressing and bandage applied in the routine fashion completes the operation.

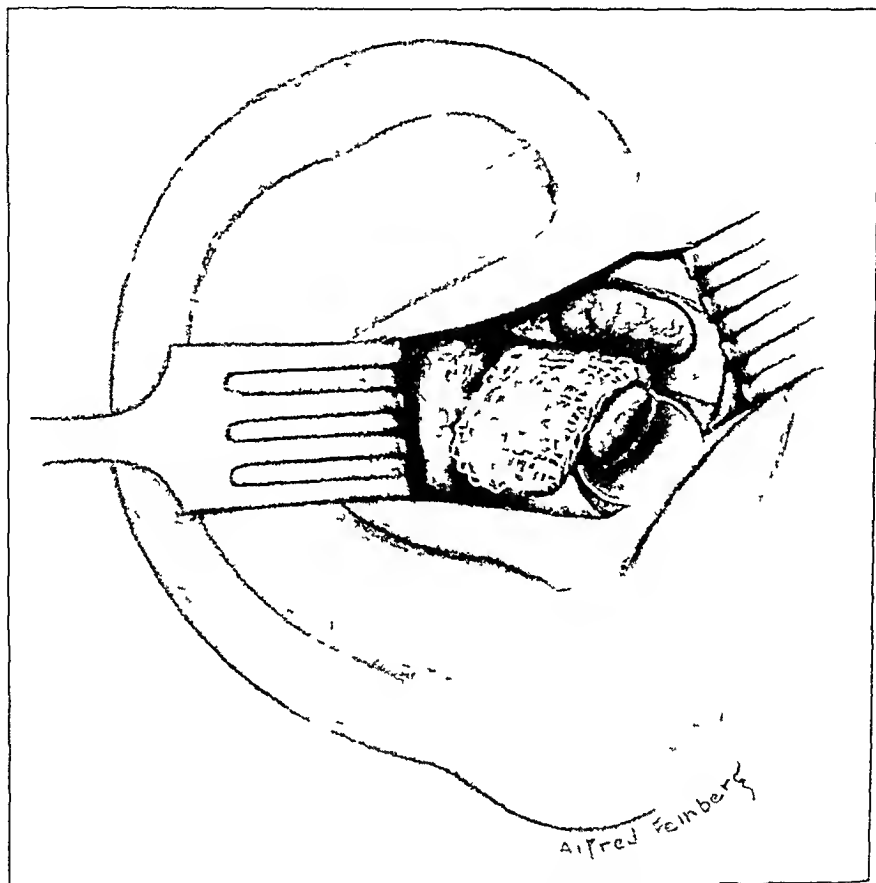


Fig. 23—Molding and maintenance of the membrane in final position with paraffin mesh

*Postoperative Care of Wound*—The superficial dressing is changed daily. On the eighth postoperative day the first full dressing is made. At this time the paraffin mesh is gently removed, care being taken not to disturb the flap. All secretions within the mastoidomeatal wound are wiped and dried with sterile cotton applicators. After the dressing is completed a piece of sterile cotton is placed in front of the entrance to the external auditory canal. The superficial bandage is discarded after the first deep dressing.

Thereafter, the mastoidomeatal wound is dressed every other day until complete epidermization of the wound has taken place

*Indications*—Technic described for the improvement of hearing may be employed with good results when there exist

- 1 Clinical evidence of fixation of the stapes
- 2 Loss of hearing by air conduction of not more than 60 per cent (if practical improvement in hearing sufficient to permit the patient to resume his economic and social life is to be obtained)
- 3 Loss of hearing by air conduction of not less than 40 per cent, when accompanied with a loss of practical hearing
- 4 Normal hearing by bone conduction determined by masking or a loss in hearing by bone conduction, determined by masking, which does not exceed 30 decibels for the 512, 1024 and 2048 frequencies
- 5 A complete absence of suppuration from the middle ear
- 6 A completely normal and translucent membrana tympani without perforations
- 7 A completely intact and healthy cutaneous lining of the bony walls of the external auditory canal
- 8 A normal state of health

#### REPORT OF CASES

CASE 1—A woman aged 44, an office worker, first noted a disturbance in hearing twenty years before examination. In 1931 there was a definite loss in hearing acuity, more marked in the left ear. After a mental upset in 1923, the hearing became much worse, and this condition progressed thereafter. No form of treatment had been of any avail. One aunt and one cousin were hard of hearing.

A preoperative hearing test (air conduction) on Nov 11, 1937, showed a 57½ per cent loss in the right ear and a 76½ per cent loss in the left ear.

On Dec 28, 1937, the Lempert operation was performed on the left ear.

Postoperative hearing tests gave the following results

	Loss in right ear (percentage)	Loss in left ear (percentage)
Dec 31, 1937	61	56
Jan 9, 1938	48	49
Jan 26, 1938	51	80
Feb 2, 1938	58	61
Feb 10, 1938	65	74
March 2, 1938	58	73
March 29, 1938	Bone conduction test showed none on left side	

*Comment*—Precoperatively this patient was never tested for bone conduction. She was an unsuitable subject because of the nerve deafness which was discovered postoperatively. The fistula closed within three weeks.

On May 14, 1938, a fistula test gave negative results. The improvement in hearing had been lost.



CASE 2—A woman aged 37, a housewife, first noticed loss of hearing in 1923. The condition improved gradually until after an operation on the left side of the nose in 1925, when she lost all practical hearing in the left ear, the hearing in the right ear was affected. The condition became progressively worse thereafter. There was no deafness in the family.

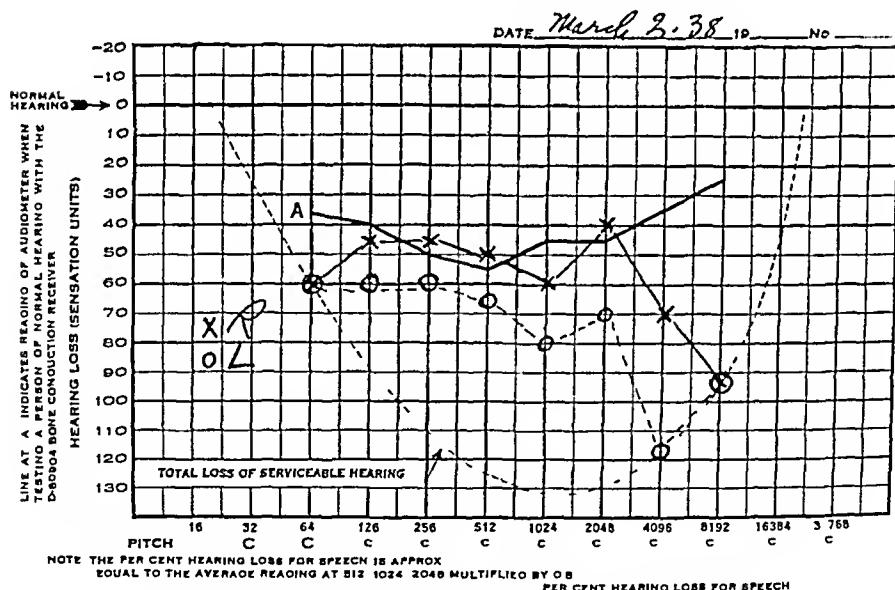
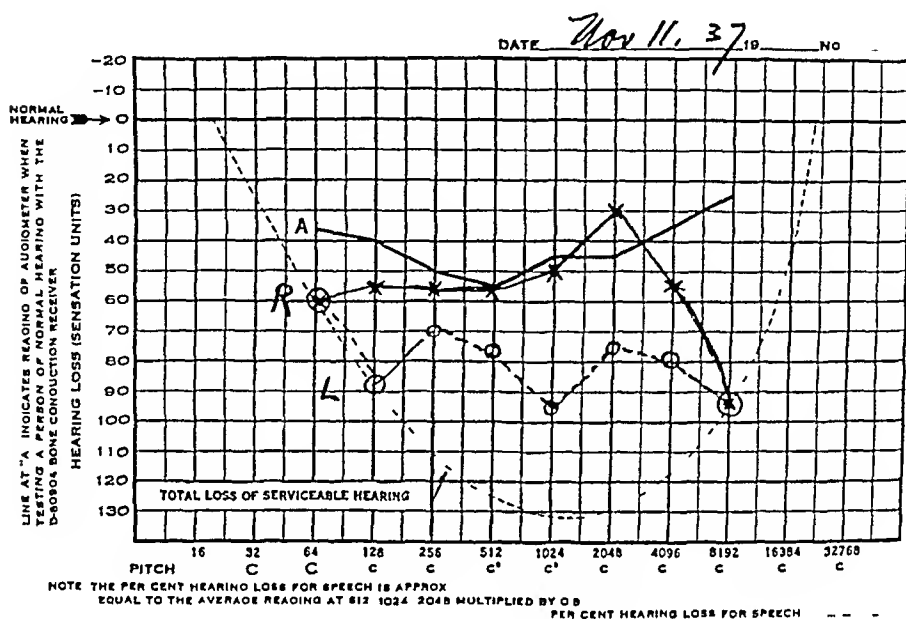


Fig 24 (case 1)—Audiograms of woman aged 44

A preoperative hearing test (air conduction) on Sept 23, 1937, showed a 52 per cent loss in the right ear and a 60 per cent loss in the left ear.

On Jan 8, 1938, the Lempert operation was performed on the left ear.

A postoperative hearing test (air conduction) on April 16, 1938, showed a 45¼ per cent loss in the right ear and a 30¾ per cent loss in the left ear.

Comment There was no temporary reduction in hearing postoperatively in this case. On May 14 1938, a fistula test gave strongly positive results. The improvement in hearing had been maintained.

CASE 3—An unemployed man aged 32 complained of a progressive loss in hearing for seven years. An intranasal operation had been performed for the

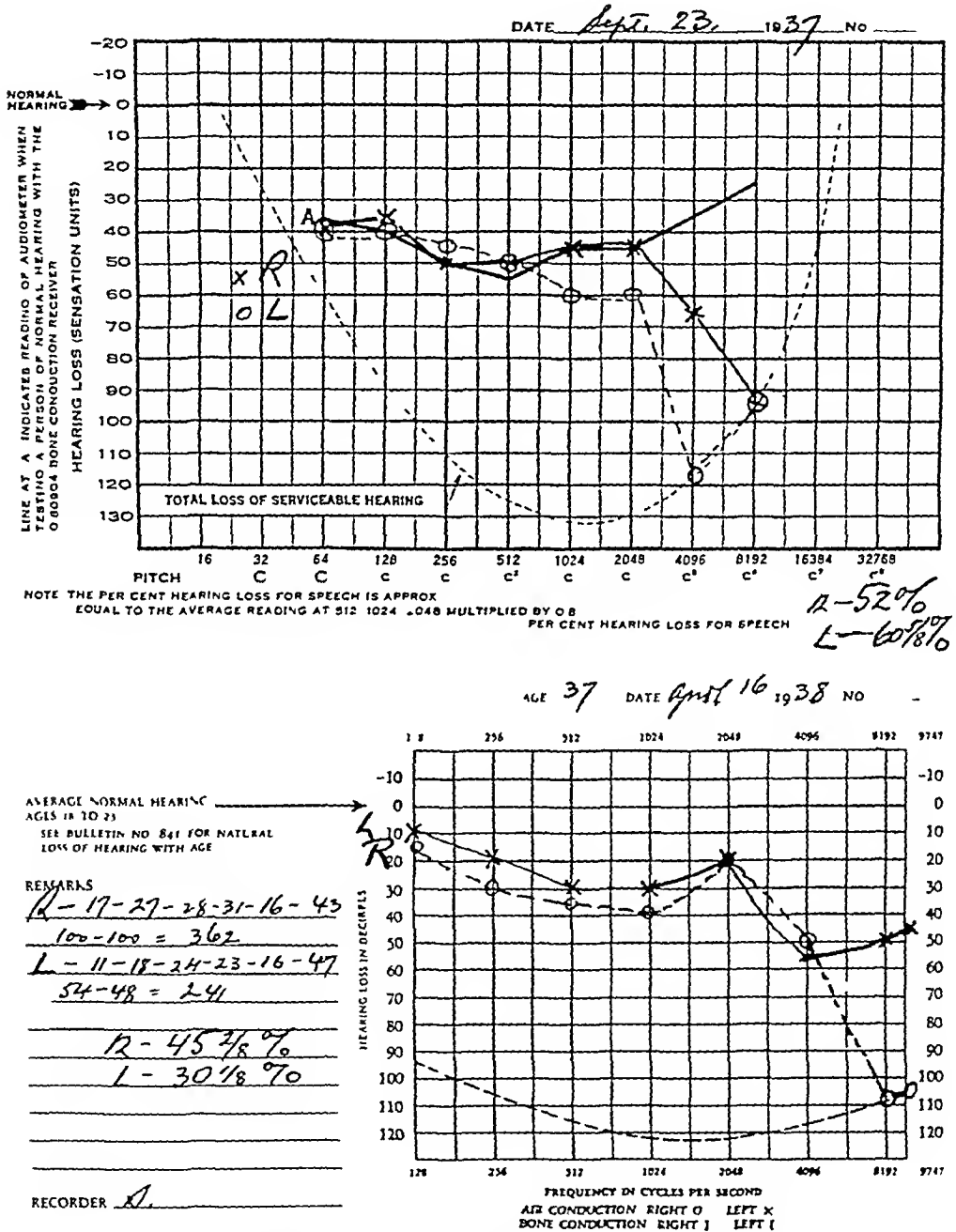


Fig 25 (case 2)—Audiograms of woman aged 37

relief of the impediment. There had been no tinnitus or otitic infection. The drum was intact. The patient used a hearing aid. One brother was hard of hearing.

A preoperative hearing test (air conduction) on Feb 4, 1938, showed a 70 3/8 per cent loss in the right ear and a 73 3/8 per cent loss in the left ear.

On Feb 9, 1938, the Lempert operation was performed on the right ear.

A postoperative hearing test (air conduction) on April 23, 1938, showed a 48% per cent loss in the right ear and a 65% per cent loss in the left ear

Comment There was no response at the time of operation, and the operation was believed to be a failure because of the marked loss in air conduction Ten days postoperatively the patient stated that he heard less than before operation, but on the following day he began to hear sounds again The reason for this

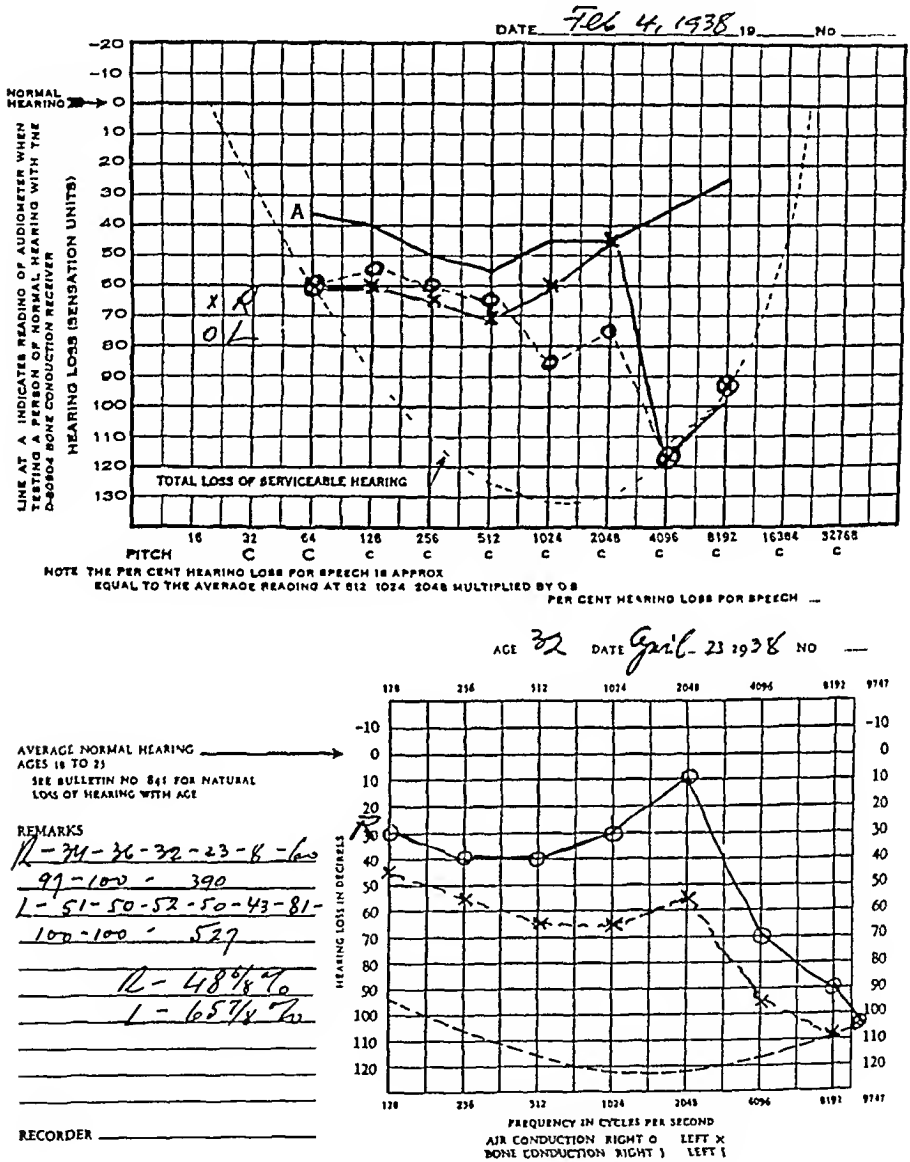


Fig 26 (case 3) —Audiograms of man aged 32

temporary loss in hearing was the presence of a postoperative hemorrhage into the tympanic cavity and into the entire mastoid wound and canal As soon as the hemorrhage was absorbed the hearing improved The patient stated that the improvement in his hearing was so great that he was able to return to his former occupation, that of salesman, and that for his practical purposes he could hear almost normally At his last visit to the office, he called the attention of

my secretary to the birds chirping outside the window. The fistula had remained patent. On May 14, 1938, a fistula test gave strongly positive results, the improvement in hearing had been maintained.

CASE 4—A woman aged 46 a housewife, first noted hardness of hearing after the birth of her first child, twenty-nine years before. A further decrease in

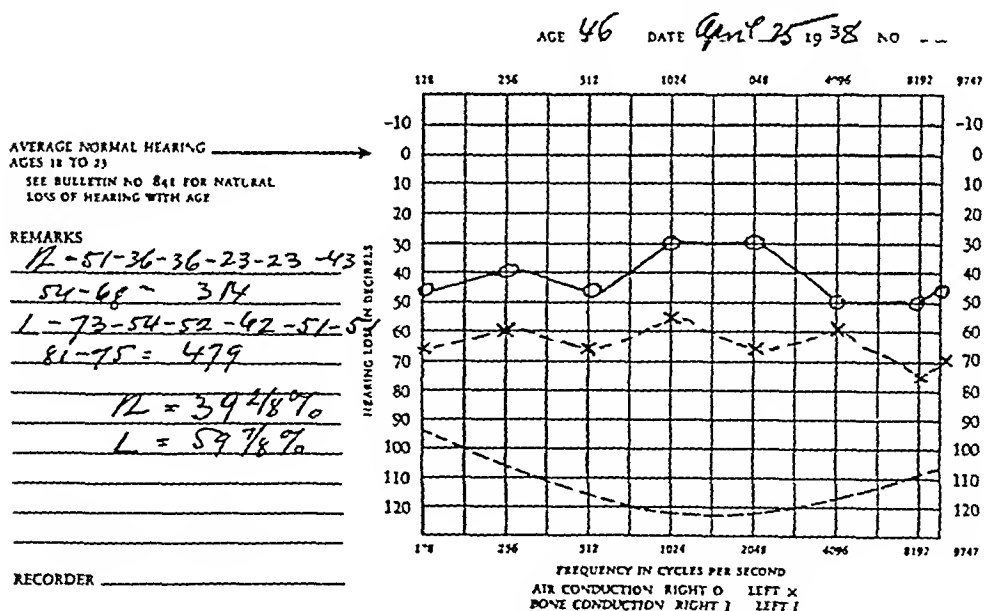
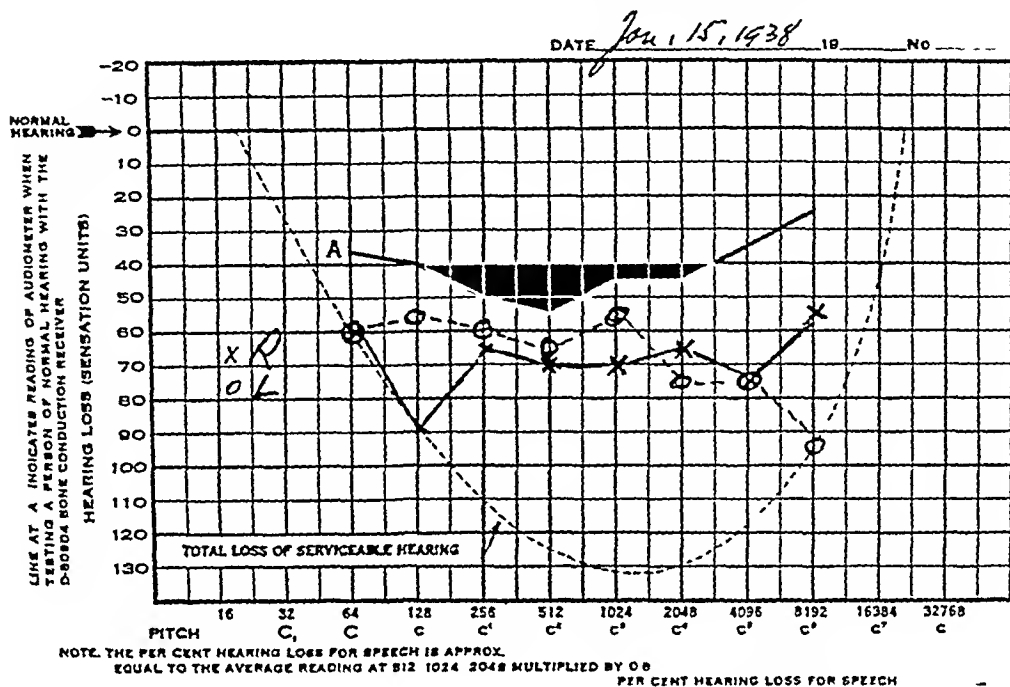


Fig 27 (case 4) —Audiograms of woman aged 46

hearing followed the birth of each of her other three children. She had no tinnitus, and there had been no deafness in the family.

Preoperative hearing tests on Jan 15, 1938, showed, by air conduction, a 68 per cent loss in the right ear and the left ear, by bone conduction hearing was within indicated limits.

On Feb 10, 1938, the Lempert operation was performed on the right ear. Considerable difficulty was encountered in the removal of the head of the malleus, but this was finally accomplished with an aural snare. Rupture of the drum extending the length of the hammer handle resulted.

After operation the hearing was excellent and remained so for three days. From then on until the dressing on the eighth day, there was a recession in the improvement, but the hearing capacity was still increased over that possessed preoperatively. At the first dressing the handle of the malleus was seen to protrude through the drum. The part of the manubrium mallei which was protruding was amputated with narrow pointed scissors. The mucoid discharge from the middle ear interfered with the acuity of hearing, but as soon as this cleared and the perforation healed, the improvement in hearing was reestablished.

A postoperative hearing test (air conduction) on April 25, 1938, showed a 38½ per cent loss in the right ear and 59½ per cent loss in the left ear.

**Comment** The patient's hearing improved markedly until April 5, when acute influenza, tonsillitis and abscess of the middle ear developed. The suppurative otitis media perforated the drum, and the hearing immediately dropped to the preoperative level. This condition lasted for ten days, after which resolution set in and there was a return of the improvement in hearing to the degree noted postoperatively.

This case suggests that the improvement in hearing following opening of the semicircular canal was due to an improvement in the mechanism of air conduction. When the air conduction was impaired by a suppurative process in the middle ear, in spite of the fact that the fistula remained open, hearing was impaired.

This case further illustrates the fact that the occurrence of suppuration in a tympanic cavity which has been shut off from the epitympanic recess and the rest of the mastoid process by the performance of the primary steps in the operation does not necessarily imply that a suppurative labyrinthitis will develop.

At no time was any thickening or inflammatory reaction of the membrane sealing the labyrinthine fenestra noted.

On May 14, 1938, the fistula test gave a strongly positive result, improvement in hearing had been maintained. At this writing the ear is dry, and the fistula is open.

**CASE 5**—A man aged 25, a sign painter, complained of progressive loss in hearing for sixteen years. One year after the onset of this condition, the patient had meningococcic meningitis. There was no tinnitus, and there had been no deafness in the family.

Preoperative hearing tests on Feb 8, 1938, showed, by air conduction, a 49 per cent loss in the right ear and a 37 per cent loss in the left ear; by bone conduction hearing was within normal indicated limits.

On Feb 11, 1938, the Lempert operation was performed on the right ear.

Postoperative hearing tests on April 27, 1938, showed, by air conduction, a 30½ per cent loss in the right ear and a 35½ per cent loss in the left ear; by bone conduction hearing was normal throughout.

**Comment** The patient regained practical hearing, was able to hear whispers and to hear in the movies and was no longer aware of any handicap. On May 14, 1938, a fistula test gave strongly positive results, the gain in hearing had been maintained.

**CASE 6**—A man aged 23, a shipping clerk, noted a gradual loss in hearing in both ears for one and one-half years. There had been no otitic infection or familial deafness, but there was tinnitus.

Preoperative hearing tests on Feb 5, 1938, showed, by air conduction, a 42 per cent loss in the right ear and a 50 per cent loss in the left ear, bone conduction was below the normal indicated limits

On Feb 13, 1938, the Lempert operation was performed on the right ear. No improvement in hearing was noted at the time

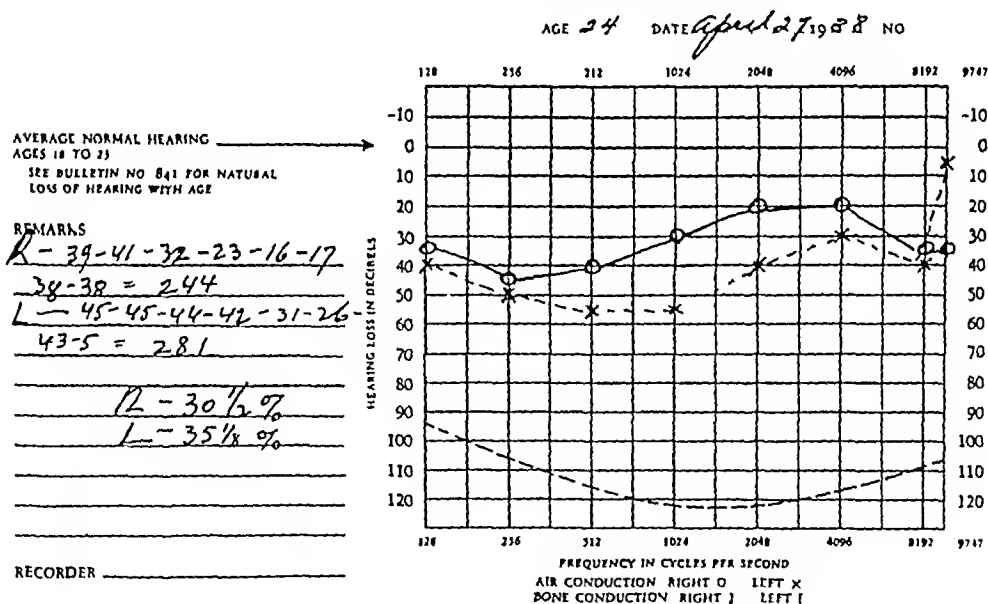
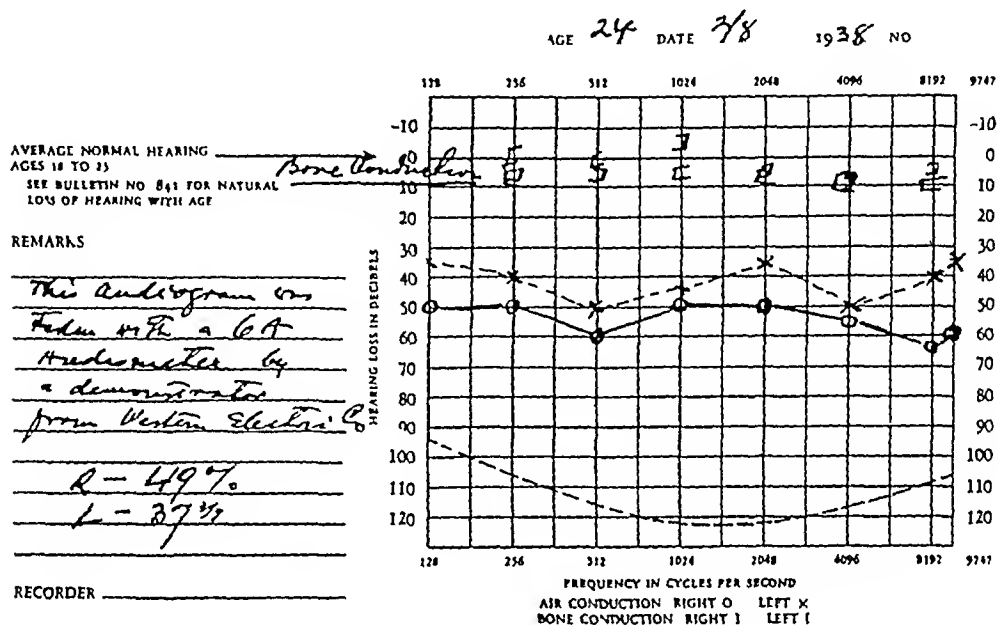


Fig 28 (case 5) —Audiograms of man aged 25

These findings regarding air and bone conduction are significant in the face of a persistent positive reaction to the fistula test on the operated ear

On Feb 28, 1938, the Lempert operation was performed on the left ear, in spite of the poor result obtained at the first operation, because the patient and his family insisted that this be done. No hearing was noted while the patient was on the table

A postoperative hearing test (air conduction) on March 2, 1938, showed an 80 per cent loss in the right ear and a 50 per cent loss in the left ear, another test (bone conduction) on March 15, 1938, showed, for the right ear, bone con-

duction lost for all tones except 1024 double vibrations (50 decibel loss), for the left ear, hearing was the same as it had been preoperatively

**Comment** No improvement in hearing for practical use resulted, and the tinnitus persisted. The patient was not considered a suitable subject for operation. On May 14, 1938, a fistula test of both ears gave strongly positive results, and both fistulas were open at the time this report was made.

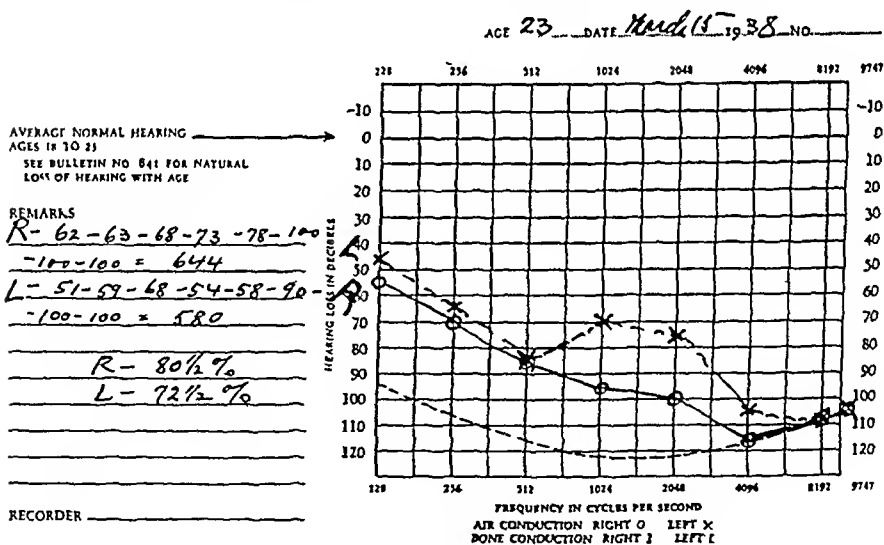
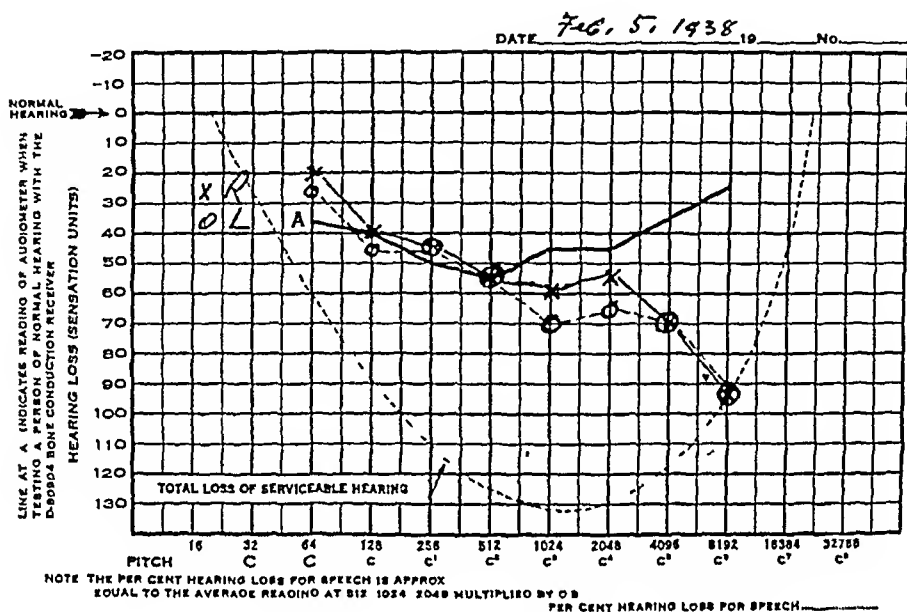


Fig 29 (case 6)—Audiograms of man aged 23

**CASE 7**—A woman aged 47, a housewife, had been hard of hearing since she was 13, the left ear being worse than the right. There had never been any tinnitus or otorrhea.

Preoperative hearing tests on Feb 10, 1938, showed, by air induction, a 76 per cent loss in the right ear and a 68 per cent loss in the left ear, bone conduction hearing was within normal indicated limits.

On Feb 16, 1938, the Lempert operation was performed on the right ear. A postoperative hearing test (air conduction) on April 19, 1938, showed a 43 per cent loss in the right ear and a 60 $\frac{3}{8}$  per cent loss in the left ear.

Comment There was no temporary reduction in hearing in this case. On May 14, 1938, a fistula test gave strongly positive results. The gain had been maintained, and hearing was normal for practical use.

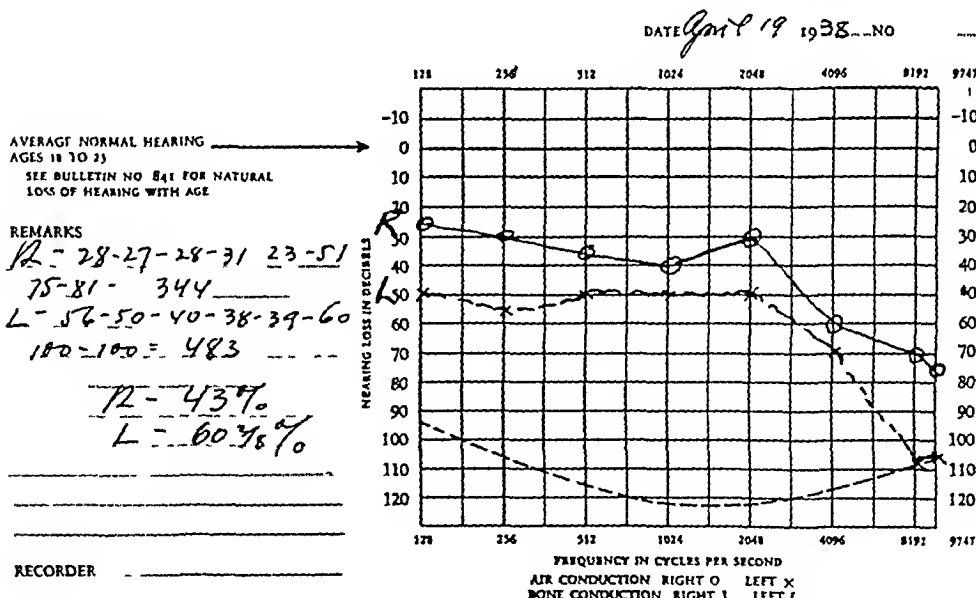
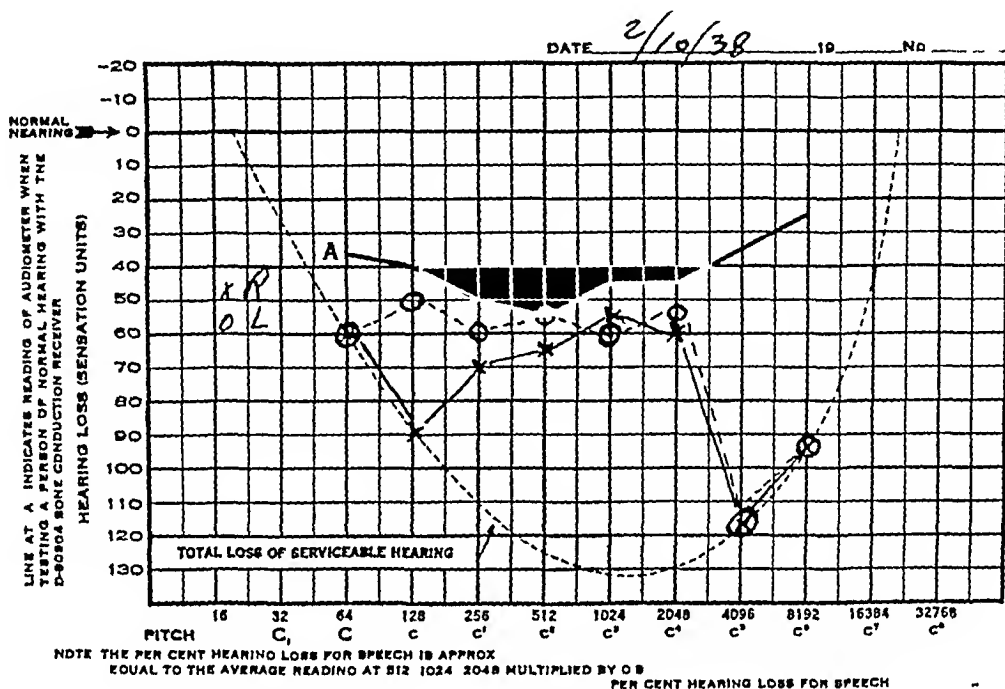


Fig 30 (case 7) —Audiograms of woman aged 47

CASE 8—A woman aged 40, a secretary, had noticed a gradual and progressive loss in hearing for fifteen years. There had been an abscess in the right ear several years before examination, and severe tinnitus had developed two years before. Because of this impediment in hearing the patient had lost her position.



Preoperative hearing tests on Feb 18, 1938, showed, by air conduction, a 47 per cent loss in the right ear and a 52 per cent loss in the left ear, by bone conduction hearing was within the normal indicated limits

On Feb 25, 1938, the Lempert operation was performed on the left ear. The hearing was excellent at the time, the improvement persisted for two days,

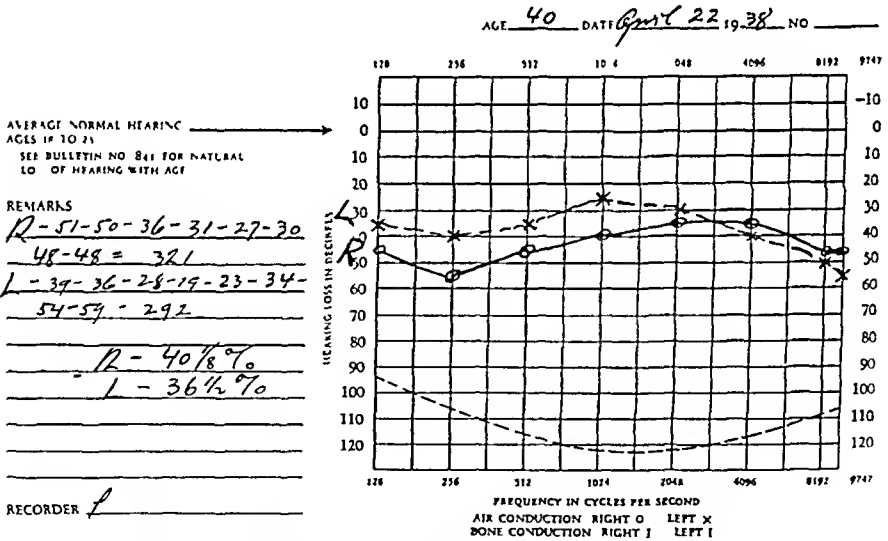
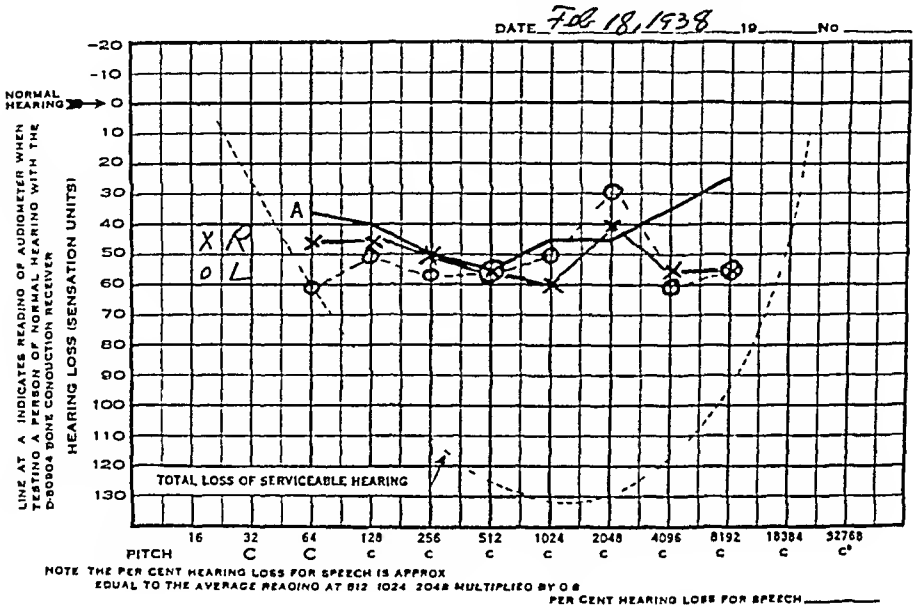


Fig 31 (case 8) —Audiograms of woman aged 40

and then hearing returned to the preoperative level. No fistula test was obtainable at the first dressing on the eighth day. The tinnitus persisted.

A postoperative hearing test (air conduction) on April 22, 1938, showed a 40 1/8 per cent loss in the right ear and a 36 1/2 per cent loss in the left ear.

Comment. On May 14, 1938, a fistula test gave strongly positive results. Hearing for practical purposes and by audiometric test was satisfactory, and the gain in hearing was maintained.

CASE 9—A woman aged 34, a housewife, first noted a loss in hearing, most marked in the right ear, and a throbbing sensation in the right ear after childbirth, five years before examination. The condition had become progressively worse. The mother, the maternal grandmother and 2 cousins were deaf.

Preoperative hearing tests on March 10, 1938, showed, by air conduction, a  $44\frac{1}{2}$  per cent loss in the right ear and a  $40\frac{7}{8}$  per cent loss in the left ear, by bone conduction hearing was within normal indicated limits.

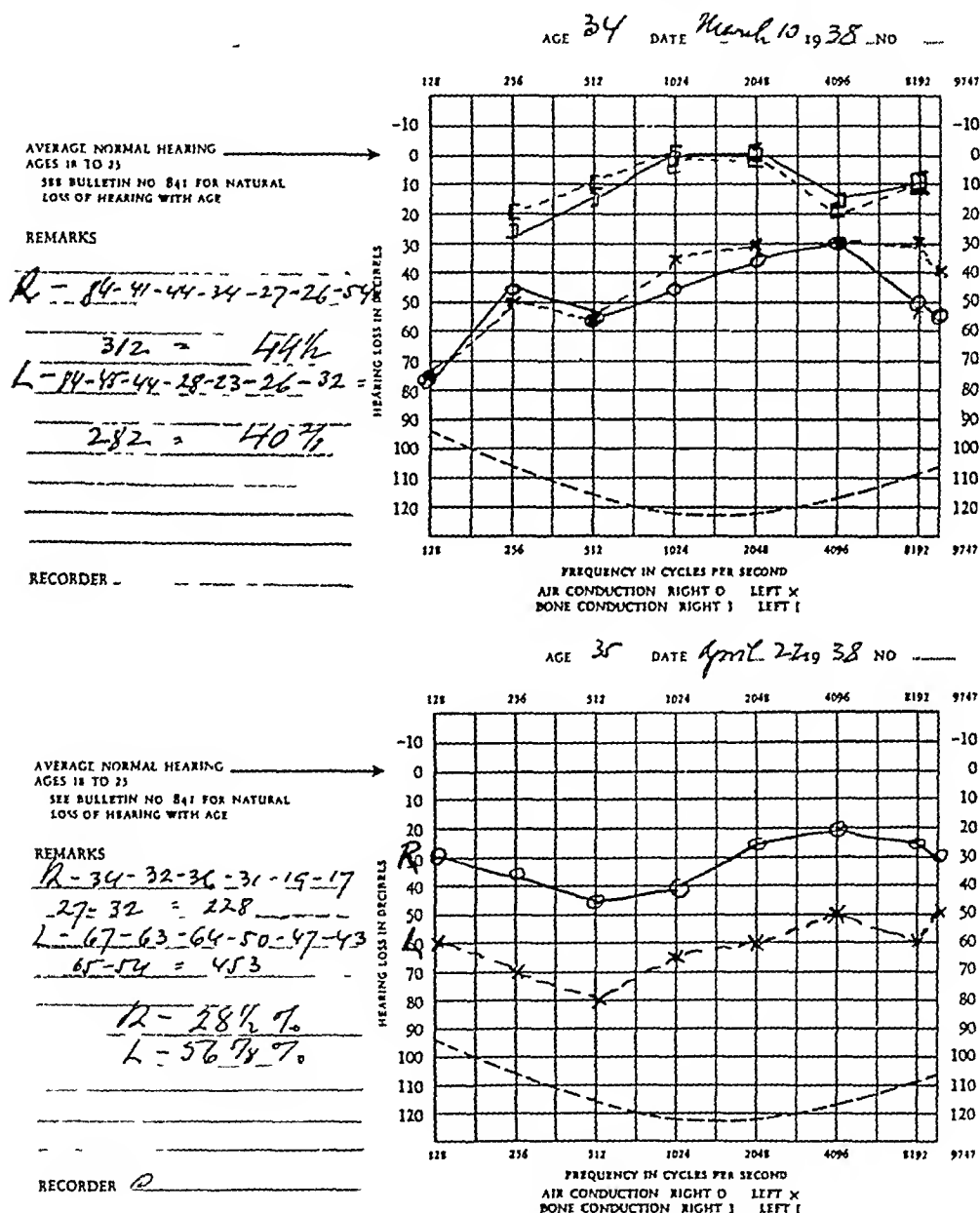


Fig 32 (case 9) —Audiograms of woman aged 34

On March 11, 1938, the Lempert operation was performed on the right ear. The mastoid cavity was extremely small, so that the meatal portion of the tympanomeatal cutaneous membrane was too long for use. It was applied, nevertheless, so as to extend and cover Trautmann's triangle. During the post-operative treatment, the distal portion of the membrane lying posterior to the external semicircular canal sloughed and had to be removed.

A postoperative hearing test (air conduction) on April 22, 1938, showed a 28½ per cent loss in the right ear and a 56½ per cent loss in the left ear

Comment Practical hearing in this case was markedly improved The fistula remained patent On May 14, 1938, a fistula test gave strongly positive results, the improvement in hearing had been maintained

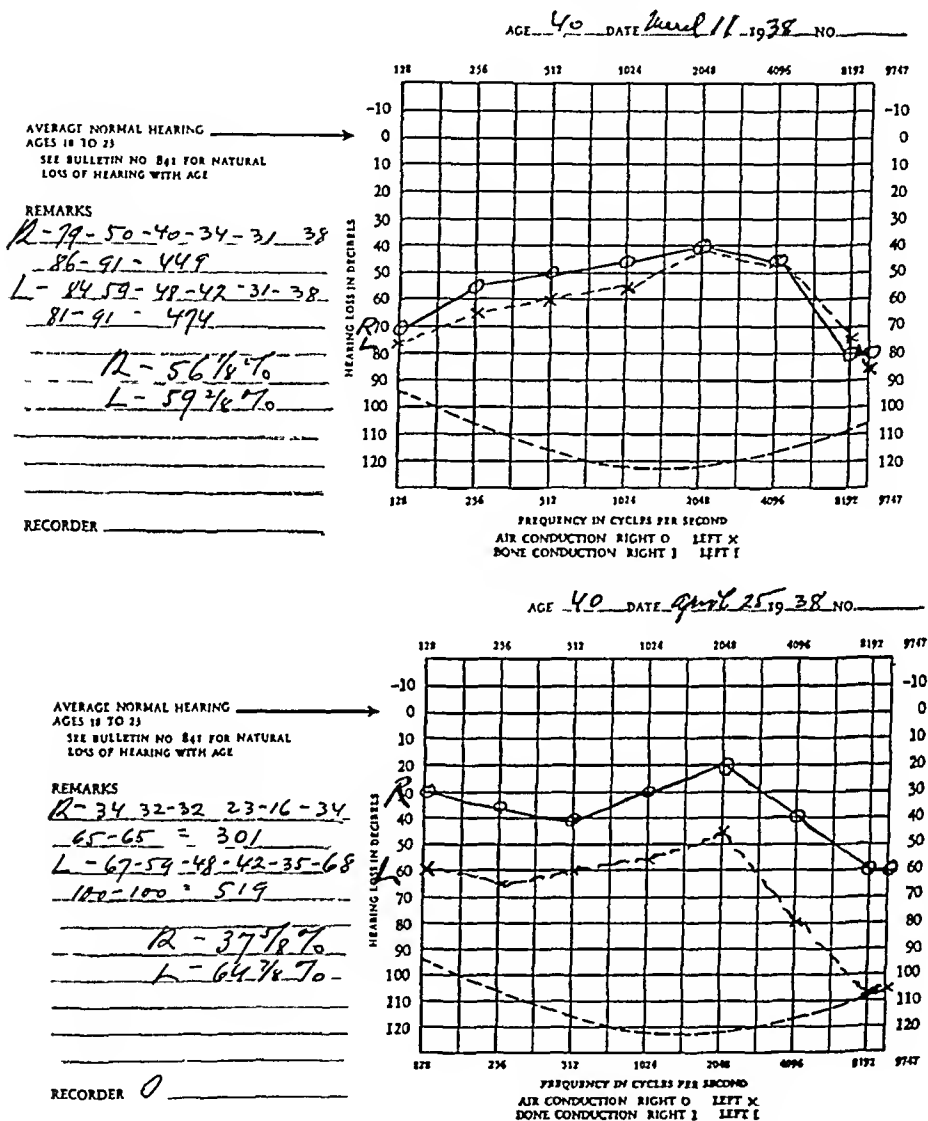


Fig 33 (case 10)—Audiograms of woman aged 40

CASE 10—A woman aged 40, a designer, while still at high school, had noted that she was losing her hearing. She had always been subject to many colds and had been treated for snail trouble. Tonsillectomy had been done during early youth. Tinnitus set in, and the hearing became progressively worse. Her father was hard of hearing. Four weeks prior to operation for the relief of deafness, the patient sustained a fracture of the tenth rib.

Preoperative hearing tests (air conduction) on March 11, 1938, showed a 56 per cent loss in the right ear and a 59 per cent loss in the left ear, by bone conduction hearing was within normal indicated limits.

On March 14, 1938, the Lempert operation was performed on the right ear. Good hearing resulted at the time.

A postoperative hearing test (air conduction) on April 25, 1938, showed a 37½ per cent loss in the right ear and a 64⅞ per cent loss in the left ear.

Comment There was a temporary reduction in hearing on the second postoperative day, which lasted for four or five days. This was due to a marked reaction in the tympanic cavity caused by the accumulation of blood. As soon

AVERAGE NORMAL HEARING  
AGES 18 TO 25  
SEE BULLETIN NO. 841 FOR NATURAL  
LOSS OF HEARING WITH AGE

## REMARKS

R - 56-50-48-54-47-77-

100-100 = 53.2

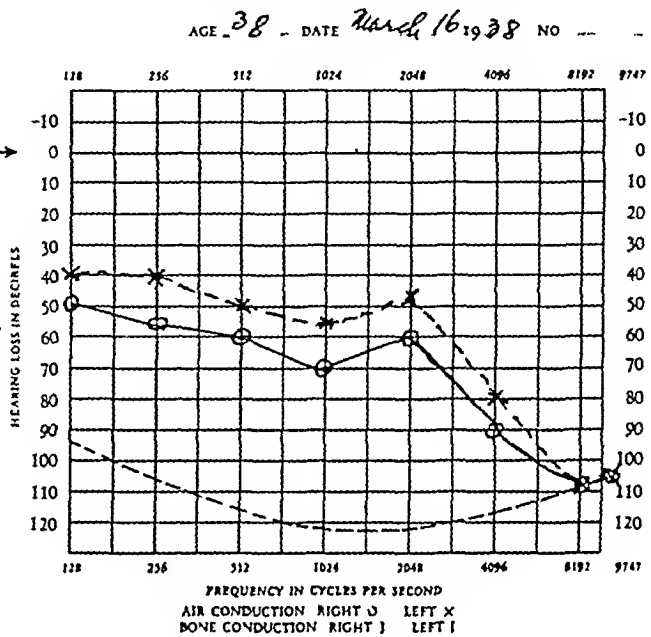
L - 45-36-40-42-35-68-

100-100 = 46.6

R - 66½%

L - 58⅞%

RECORDER



AVERAGE NORMAL HEARING  
AGES 18 TO 25  
SEE BULLETIN NO. 841 FOR NATURAL  
LOSS OF HEARING WITH AGE

## REMARKS

R - 74-32-28-23-31-43

65-70 = 32.6

L - 39-45-40-46-43-51

-100-100 = 46.4

R - 40⅞%

L - 58%

RECORDER A

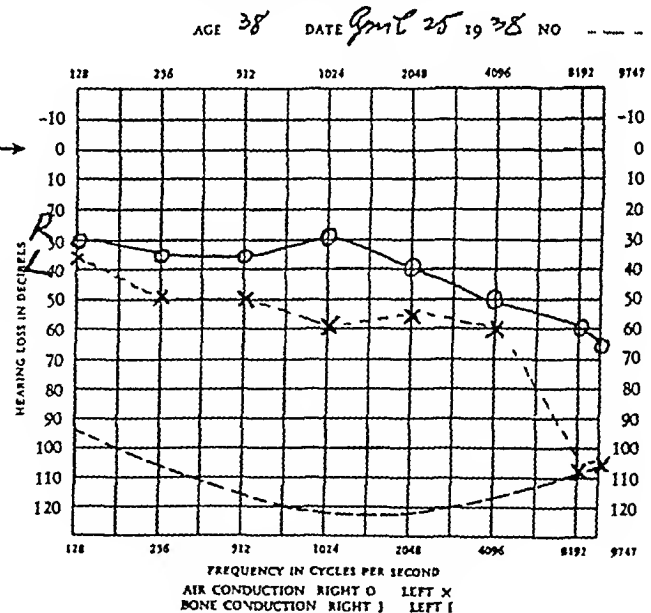


Fig. 34 (case 11)—Audiograms of woman aged 37

as the reaction began to subside, improvement in hearing returned and continued thereafter.

On May 14, 1938, a fistula test gave strongly positive results. The gain in hearing had been maintained. Today the patient has good practical hearing and a functioning fistula.

CASE 11—A woman aged 37, a housewife, had a progressive loss in hearing following a cold sixteen years before examination. She complained of severe

tinnitus There was no otitic infection A mother and sister were hard of hearing The patient had had a pulmonary infection, but all examinations failed to show any evidence of tuberculosis The patient used a hearing aid but experienced difficulty with it

Preoperative hearing tests on March 16, 1938, showed, by air conduction, a 60 per cent loss in the right ear and a 58 per cent loss in the left ear, by bone conduction hearing was within normal indicated limits

On March 23, 1938, the Lempert operation was performed on the right ear Hearing at the time was excellent

A postoperative hearing test (air conduction) on April 25, 1938, showed a 40½ per cent loss in the right ear and a 58 per cent loss in the left ear

Comment Tinnitus persisted The patient discarded her hearing aid and for practical purposes heard well

On May 14, 1938, a fistula test gave strongly positive results The gain in hearing had been maintained The fistula has remained open

CASE 12—A woman aged 32, a social worker, had undergone right mastoidectomy at the New York Eye and Ear Infirmary twenty-two years before examination Two revisions were performed at the same institution After that there was a gradual loss in hearing in both ears Tinnitus was persistent The patient used a hearing aid but could not hear with it

Preoperative hearing tests on Feb 18, 1938, showed, by air conduction, a 70 per cent loss in the right ear and a 76 per cent loss in the left ear, by bone conduction hearing was within normal indicated limits

On March 24, 1938, the Lempert operation was performed on the left ear Marked improvement in hearing was observed at the time

A postoperative hearing test (air conduction) on April 22, 1938, showed a 63½ per cent loss in the right ear and a 49¾ per cent loss in the left ear

Comment The tinnitus, which was marked before operation, completely disappeared The patient heard well enough to be able to seek employment and no longer needed a hearing aid On May 14, 1938, a fistula test gave strongly positive results The improvement in hearing had been maintained

CASE 13—A woman aged 38, a bookkeeper, attributed her deafness to an acute accident twelve years before examination Since then there had been a progressive loss in hearing in both ears and marked tinnitus The patient used a hearing aid for the left ear but could not hear well with it She was unable to hear with or without a hearing aid with the right ear

Preoperative hearing tests on March 12, 1938, showed, by air conduction, a 75 per cent loss in the right ear and a 64 per cent loss in the left ear, by bone conduction hearing was within normal indicated limits

On March 25, 1938, the Lempert operation was performed on the right ear A marked improvement in hearing was observed at the time

A postoperative hearing test (air conduction) on April 12, 1938, showed a 55½ per cent loss in the right ear and a 55½ per cent loss in the left ear

Comment The patient reported that she could hear with the ear which had been operated on When she put the telephone receiver to the other ear she did not hear but was able to hear with the one operated on Improvement, according to the audiometric test, was equally marked in the two ears after operation Tinnitus disappeared in the right ear and became much milder in the left ear On May 14, 1938, a fistula test gave strongly positive results The gain in hearing had been maintained

CASE 14—A man aged 26, a hair dresser, had had marked tinnitus in both ears for five years. After inflation of the eustachian tube he suddenly became deaf. He was unable to hear even shouting after that. His sister and father were hard of hearing.

A preoperative hearing test (air conduction) on Jan 7, 1937 showed an 88 per cent loss in the right ear and a 75 per cent loss in the left ear.

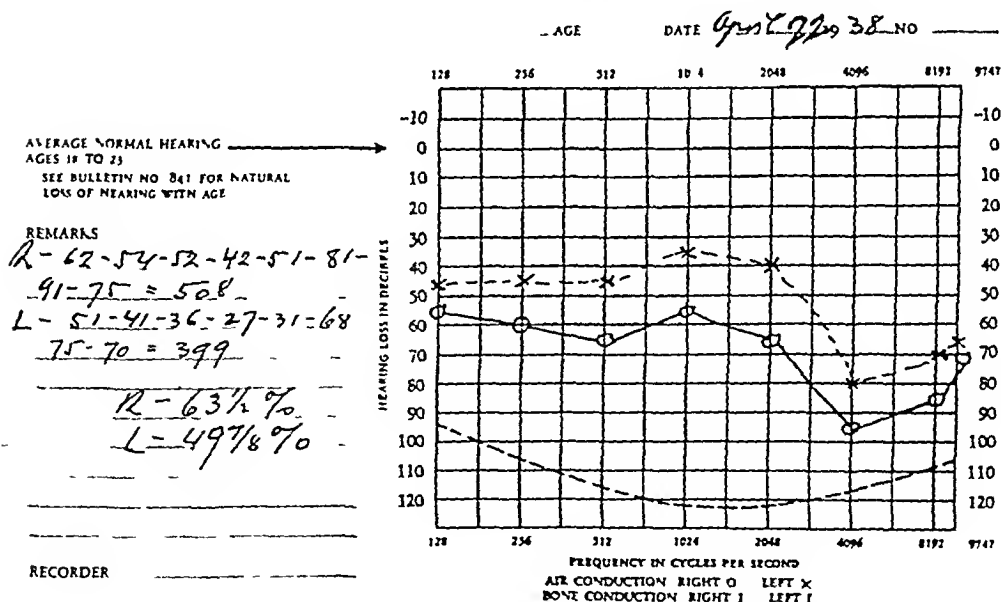
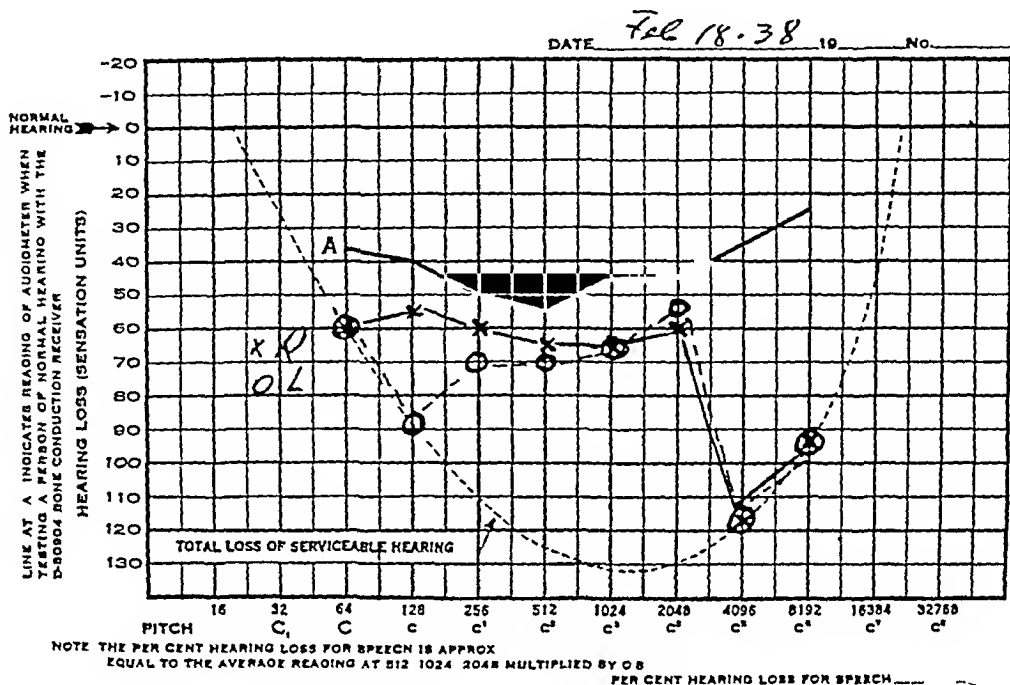


Fig 35 (case 12)—Audiograms of woman aged 32

On Jan 7, 1937 right radical mastoidectomy was performed the malleus and the incus being removed but the entire drum being preserved. After completion of the operation the drum was separated from the annulus tympanicus, except at its attachment to the upper half of the anterior aspect and was then applied and made to adhere to the mesial tympanic wall. The object of the procedure was twofold (1) to shut off the eustachian tube and (2) to obtain an outgrowth

of thin epidermis for subsequent use as a flap for the sealing of the fistula in the external semicircular canal

After this radical operation the hearing by audiometric tests showed an improvement, but there was no improvement in practical hearing

A postoperative hearing test (air conduction) on Jan 13, 1937, showed a 63 per cent loss in the right ear and a  $79\frac{1}{8}$  per cent loss in the left ear

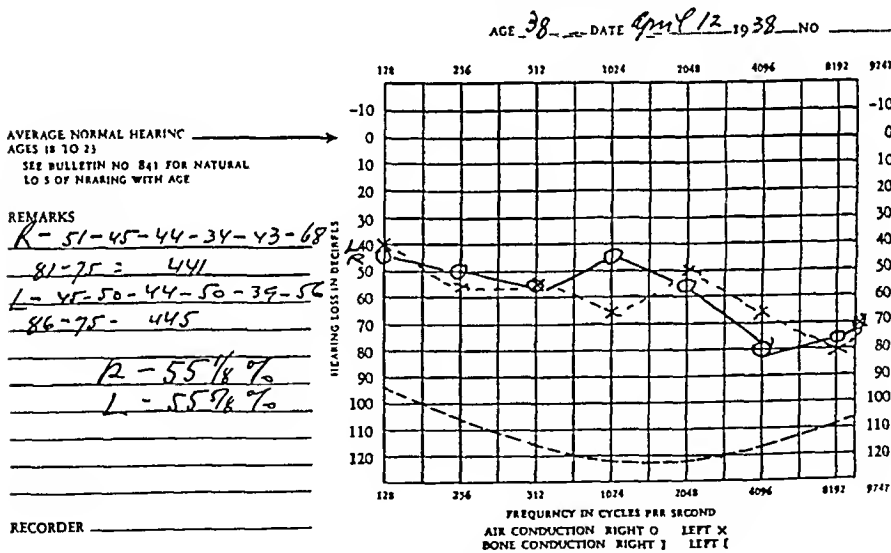
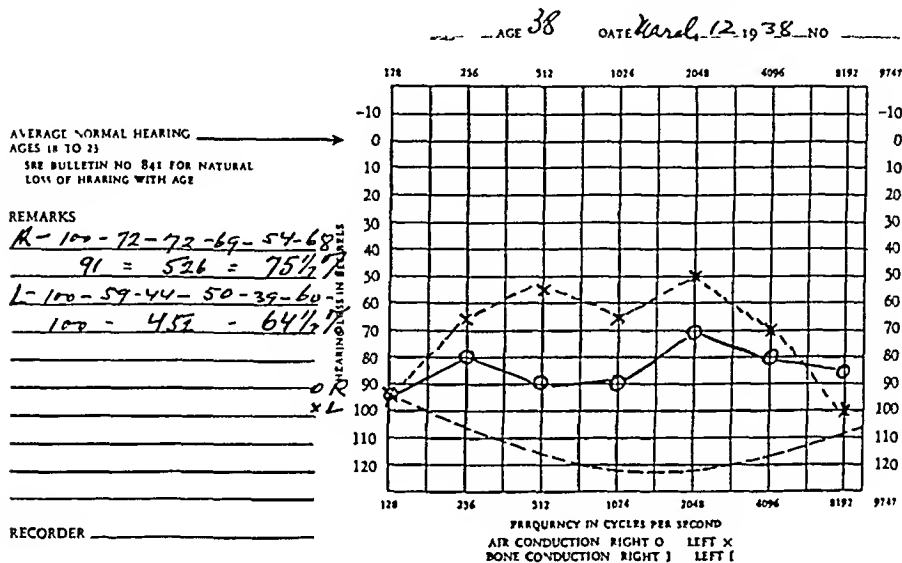
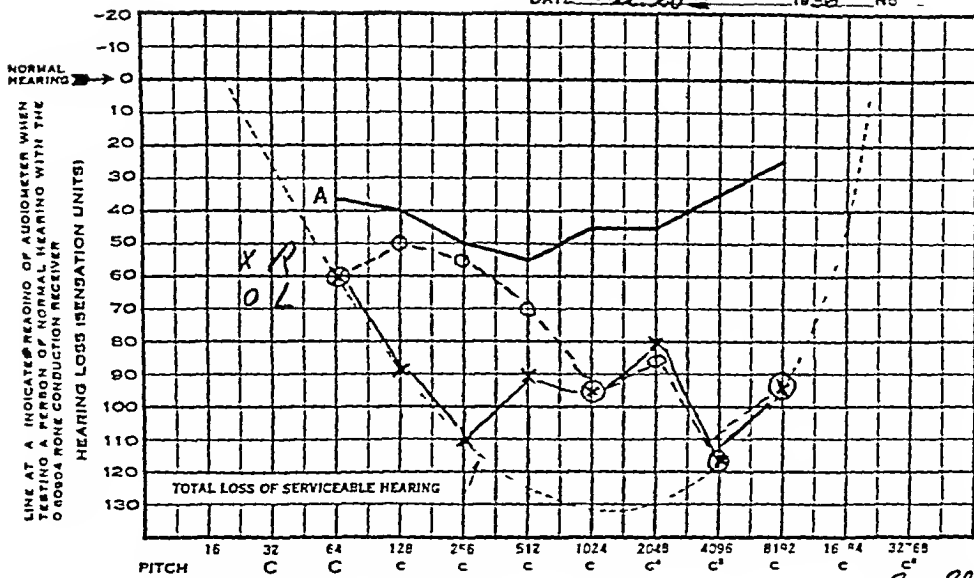


Fig 36 (case 13) —Audiograms of woman aged 38

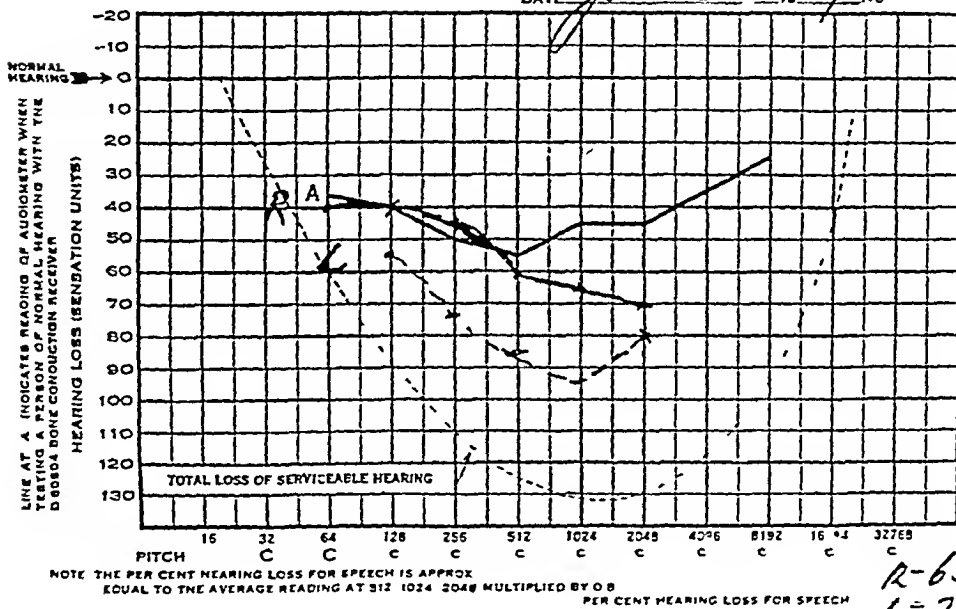
On March 19, 1937, the epidermal outgrowth was dissected from the bone, and the external semicircular canal was opened. The flap was found to be too thin and not sufficiently long to cover the entire fenestra in the canal. The immediate hearing was excellent (14 feet [427 cm] for ordinary spoken voice). This dropped on the third day to the level noted prior to operation.

On Jan 11, 1938, the Lempert operation was performed on the left ear. Immediate improvement was noted.

DATE Dec 20th 1936 No     



DATE Jan 13 1937 No     



DATE Jan 22-38 19     No     

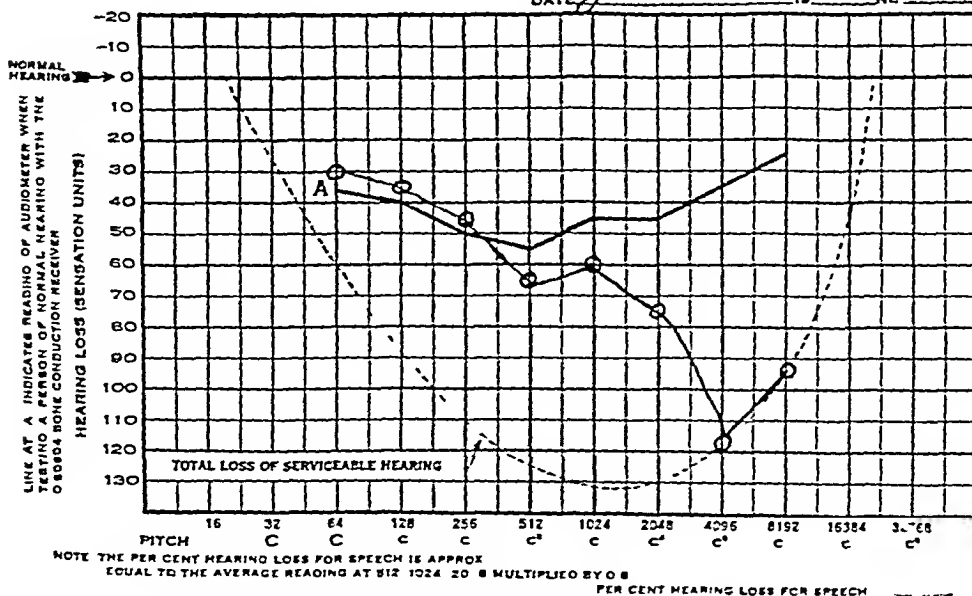


Fig 37 (case 14) —Audiograms of man aged 26



A postoperative hearing test (air conduction) on Jan 22, 1938, showed a 60 per cent loss in the left ear

Comment This patient, who did not hear for practical purposes even with a hearing apparatus, was able, after operation, to hear better than he had before without a bone conduction aid. Despite this fact and the impressive audiometric improvement, the loss in hearing preoperatively was too great to warrant operation with expectation of practical improvement in hearing. On May 14, 1938, a fistula test gave strongly positive results. No practical improvement was noted in hearing

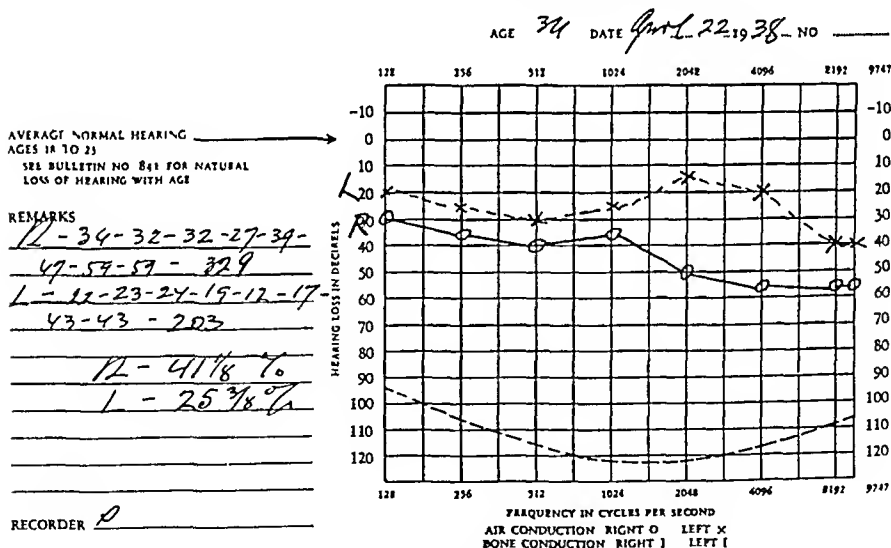
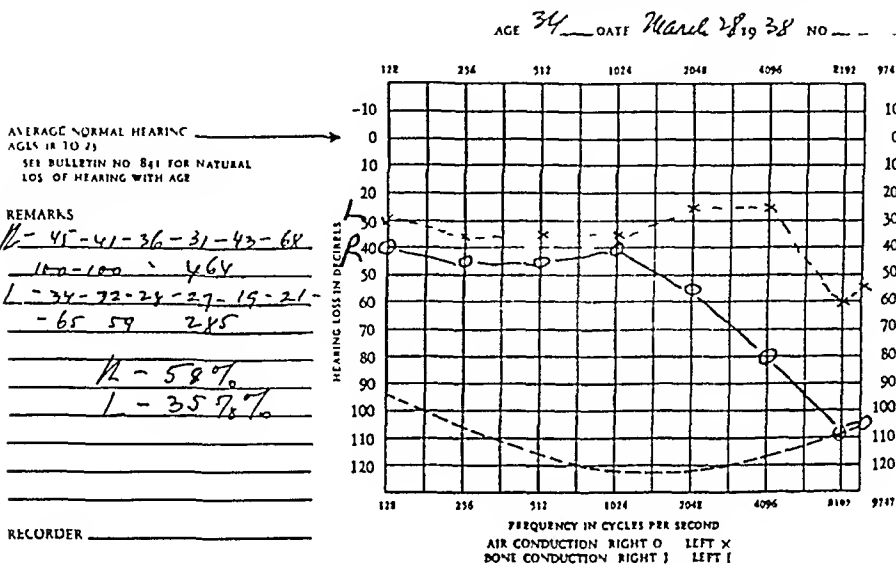


Fig 38 (case 15)—Audiograms of woman aged 29

CASE 15—A woman aged 29, a stenographer, had been hard of hearing for twelve years, the defect being worse in the right ear. She complained of severe tinnitus in both ears. The condition became progressively worse. Tonsillectomy had been performed five years before examination and a nasal operation a year later. There had been no otitic suppuration, and both drums were normal. The father was deafened.

Preoperative hearing test on March 28, 1938, showed, by air conduction, a 58 per cent loss in the right ear and a 35 per cent loss in the left ear, by bone conduction hearing was within normal indicated limits

On March 29, 1938, the Lempert operation was performed on the right ear

A postoperative hearing test (air conduction) on April 22, 1938, showed a  $41\frac{1}{8}$  per cent loss in the right ear and a  $25\frac{3}{8}$  per cent loss in the left ear

Comment The fistula was maintained The tinnitus completely disappeared There was marked improvement in practical hearing, the patient being able to

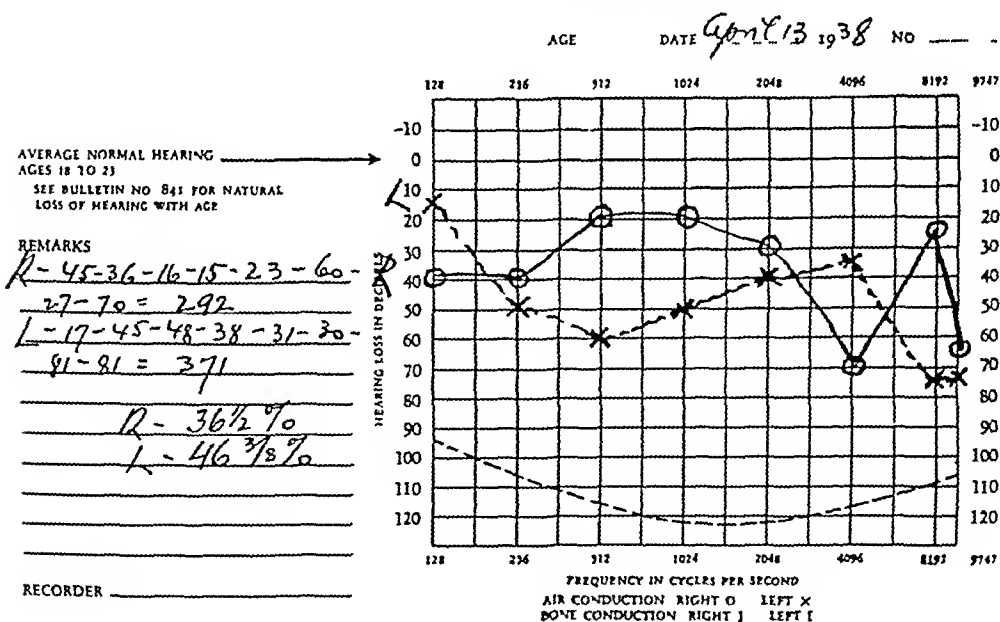
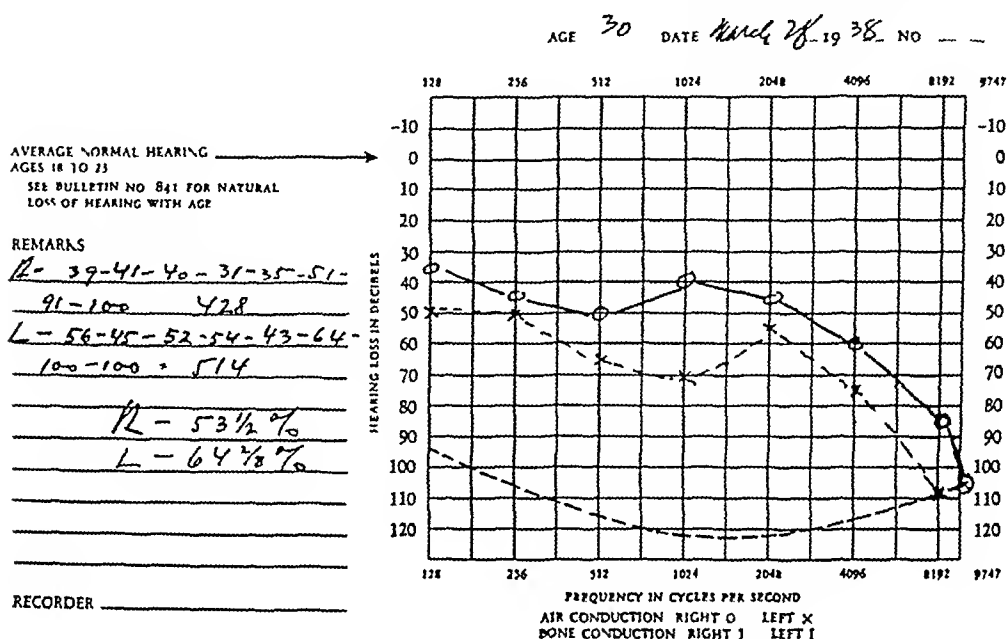


Fig 39 (case 16)—Audiograms of man aged 32

hear whispers On May 14, 1938, a fistula test gave strongly positive results, improvement in hearing had been maintained

CASE 16—A man aged 32, a roofer, had been hard of hearing for twenty years, during the last six years of the period the condition had become progressively worse, it was more marked in the left ear There had been deafness

in the family Thyroxin was injected into the ear without any result A nasal operation had been performed four years before examination There was no otitic infection

Preoperative hearing tests on March 28, 1938, showed, by air conduction, a  $53\frac{1}{2}$  per cent loss in the right ear and a  $64\frac{1}{4}$  per cent loss in the left ear, by bone conduction hearing was within normal indicated limits

On March 30, 1938, the Lempert operation was performed on the right ear

A postoperative hearing test (air conduction) on April 13, 1938, showed a  $36\frac{1}{2}$  per cent loss in the right ear and a  $46\frac{1}{8}$  per cent loss in the left ear

Comment Practical hearing was restored and maintained in this case On May 14, 1938, a fistula test gave strongly positive results The improvement in hearing had been maintained

CASE 17—A man aged 30, a sales promoter, had a father and a paternal aunt who were hard of hearing When still a boy, the patient accidentally discovered that when he applied the telephone receiver to the left ear he could not hear This condition became progressively worse until five years before examination, when the loss in practical hearing became evident in both ears Tinnitus in both ears was brought on by changes in the weather The patient could not hear the spoken voice without a bone conduction aid There was no otitic inflammation Tonsillectomy and adenoidectomy had been performed twelve years before

Preoperative hearing tests on March 26, 1938, showed, by air conduction, a  $62\frac{1}{4}$  per cent loss in the right ear and a 79 per cent loss in the left ear, by bone conduction hearing was within normal indicated limits

On March 31, 1938, the Lempert operation was performed on the right ear

A postoperative hearing test (air conduction) on April 20, 1938, showed a  $48\frac{3}{4}$  per cent loss in the right ear and a 79 per cent loss in the left ear

Comment The patient discarded his hearing aid, and for practical purposes his hearing was much improved On May 14, 1938, a fistula test gave strongly positive results The gain in hearing had been maintained

CASE 18—A woman aged 27, a housewife, had been hard of hearing for about six years, but in the two years before examination the condition had become worse She stated that a cold and an abscess in the right ear had preceded the onset of the deafness Tonsillectomy had been performed The patient had tinnitus A paternal aunt was hard of hearing Since childbirth, one year before, hearing had become much worse The patient wore a hearing aid

A preoperative hearing test (air conduction) on March 17, 1938, showed a  $79\frac{5}{8}$  per cent loss in the right ear and a  $72\frac{5}{8}$  per cent loss in the left ear

On April 2, 1938, the Lempert operation was performed on the right ear

A postoperative hearing test (air conduction) on April 27, 1938, showed a 78 per cent loss in the right ear and an  $81\frac{1}{2}$  per cent loss in the left ear

Comment There was no response in hearing at the time of operation, and there was no improvement thereafter The patient had poor bone conduction within the conversational voice range before operation and was told that she was not a suitable subject for operation, but she insisted on being given the trial On May 14, 1938, a fistula test gave strongly positive results There was no improvement in hearing

CASE 19—A man aged 29, a landscape inspector, had had an attack of pleurisy eighteen years before examination He was known to have a chronic but well compensated valvular disease He first became hard of hearing in October 1937 and had had throbbing and whistling noises in his left ear since then There was no deafness in the family

A preoperative hearing test (air conduction) on March 14, 1938, showed a  $59\frac{1}{8}$  per cent loss in both ears

On March 25, 1938, the Lempert operation was performed on the right ear

A postoperative hearing test (air conduction) on April 25, 1938, showed a  $37\frac{1}{4}$  per cent loss in the right ear and a  $55\frac{3}{4}$  per cent loss in the left ear

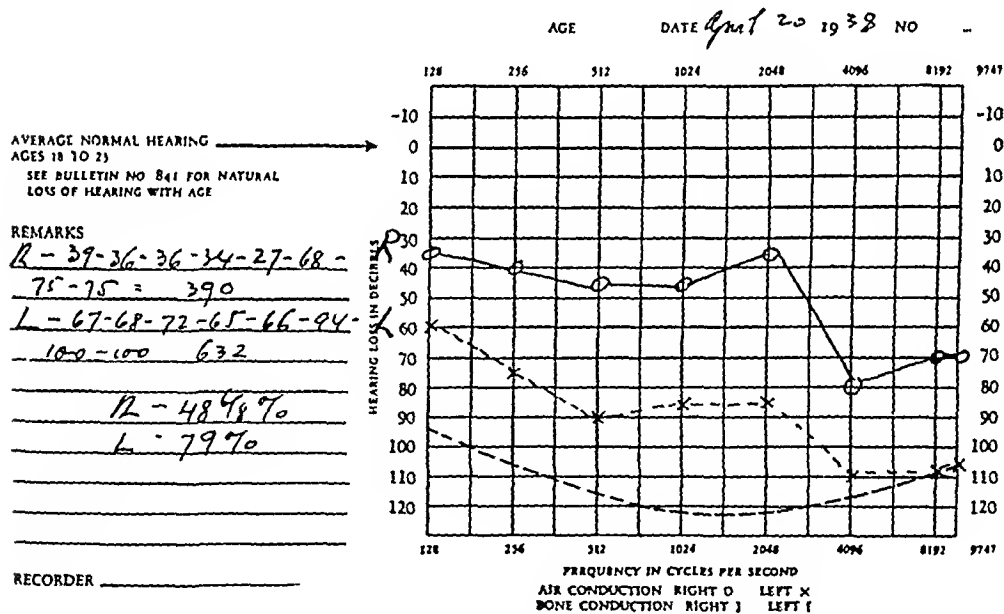
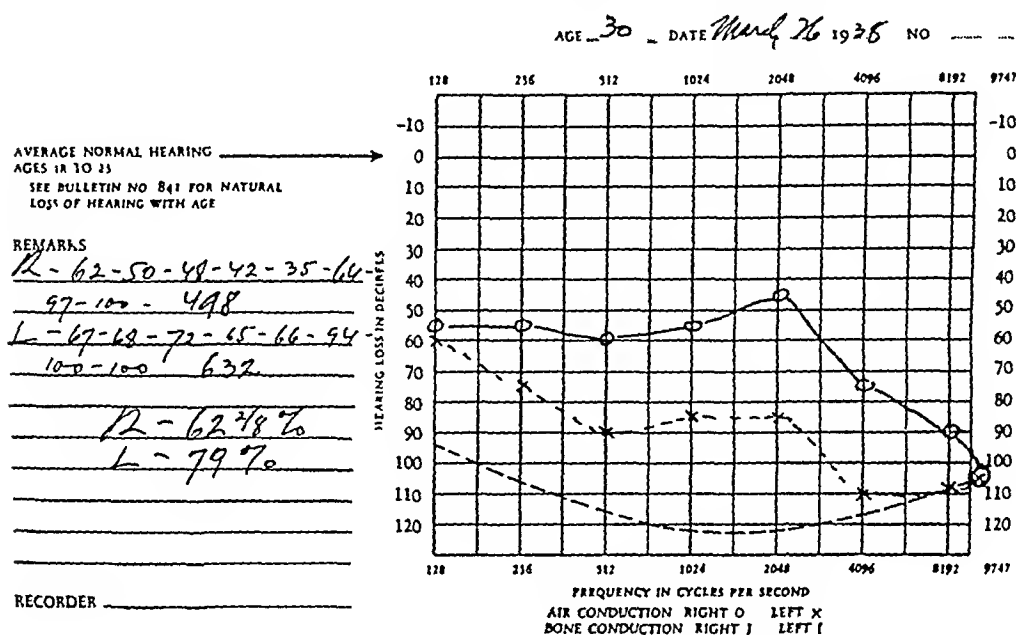


Fig 40 (case 17)—Audiograms of man aged 30

Comment This patient, who had passed a civil service examination, was rejected because of his poor hearing. He was given a three months' probationary period during which he could seek treatment. The operation was performed, and his practical hearing so markedly improved that he passed the physical examination of the Civil Service Commission.

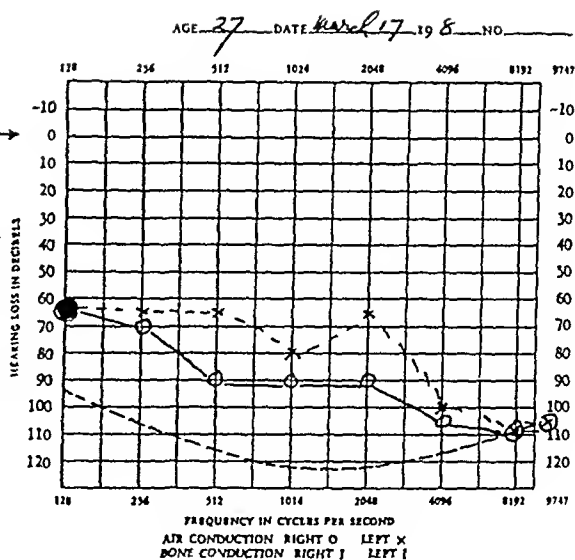
A study of the charts of preoperative and postoperative hearing in this case shows the improvement in postoperative hearing for the frequencies of 128, 256,

AVERAGE NORMAL HEARING  
AGES 18 TO 25  
SEE BULLETIN NO. 841 FOR NATURAL  
LOSS OF HEARING WITH AGE

# REMARKS

R-73-63-72-69-70-90-  
100-100 = 63.7  
L-73-59-52-61-51-85  
100-100 = 58.1  
R-79.7%  
L-72.5%

RECORDER

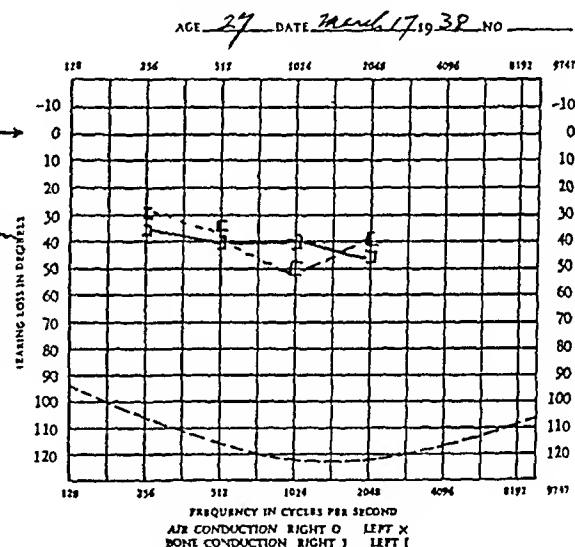


AVERAGE NORMAL HEARING  
AGES 18 TO 25  
SEE BULLETIN NO. 841 FOR NATURAL  
LOSS OF HEARING WITH AGE

# REMARKS

Bone Conduction

RECORDER



AVERAGE NORMAL HEARING  
AGES 18 TO 25  
SEE BULLETIN NO. 841 FOR NATURAL  
LOSS OF HEARING WITH AGE

# REMARKS

R-62-59-72-76-70-85-  
100-100 = 62.4  
L-73-68-76-65-70-100-  
100-100 = 65.2  
R-78%  
L-81.2%

RECORDER

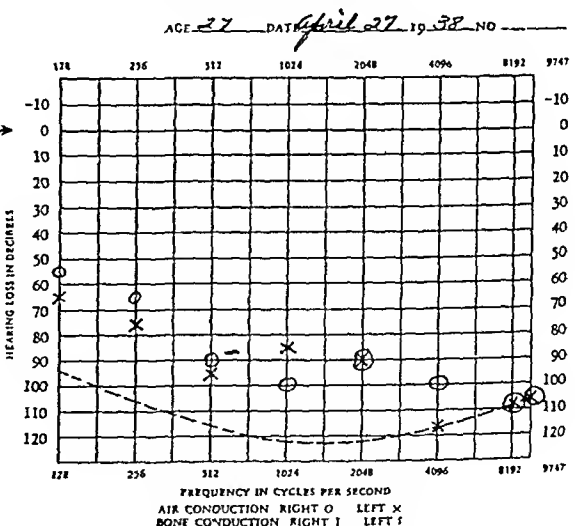


Fig 41 (case 18) —Audiograms of woman aged 27

512 and 1024 double vibrations The drop in perception of the high notes, however, accounts for the reduction in the average estimation of hearing by percentage On May 14, 1938, a fistula test gave strongly positive results The gain in hearing had been maintained

CASE 20—A woman aged 42, a housewife, first became hard of hearing about ten years before examination The defect gradually became worse and was

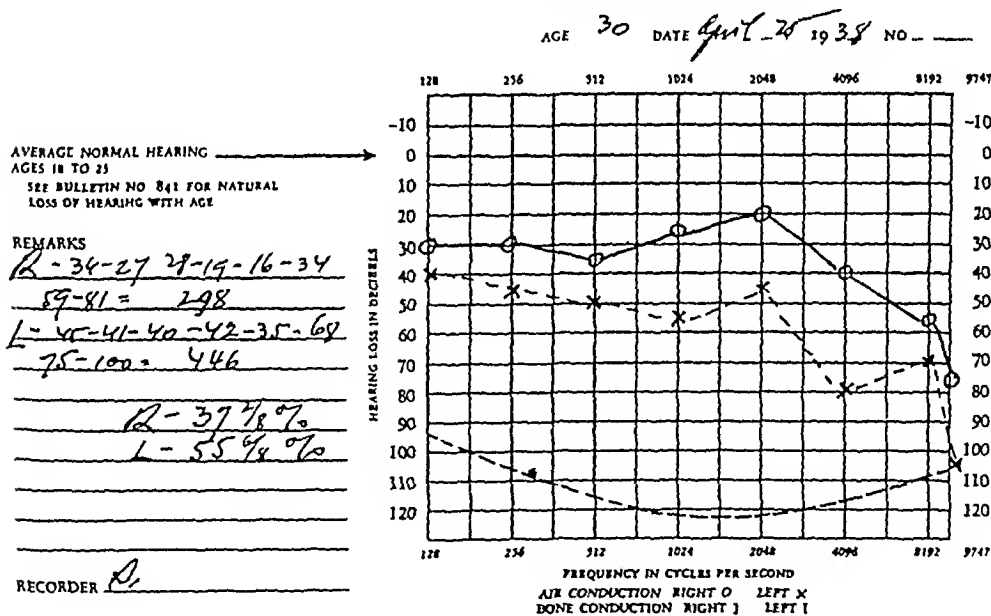
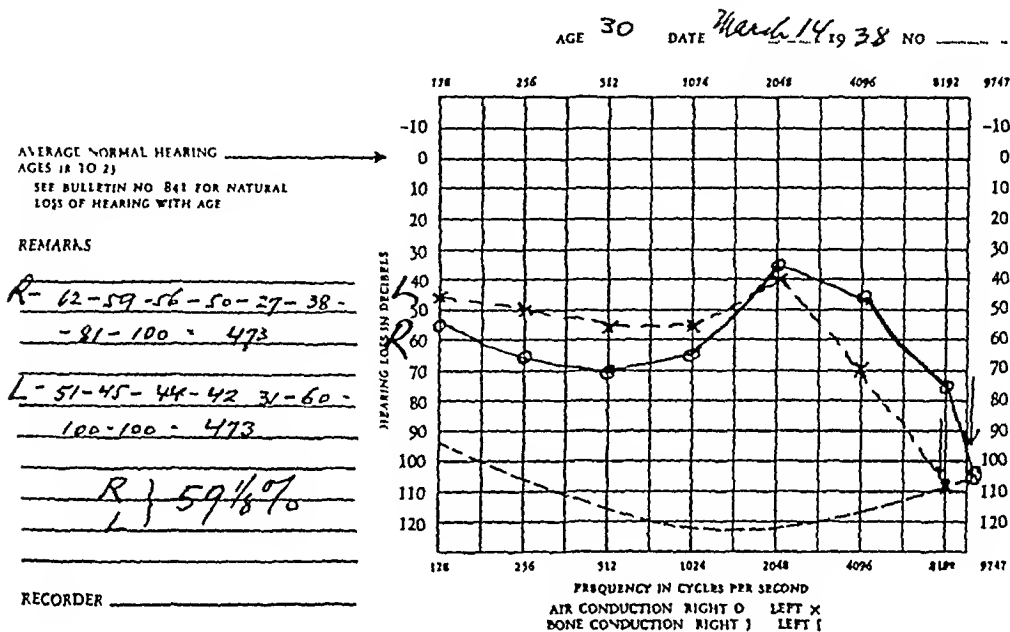


Fig 42 (case 19)—Audiograms of man aged 29

accompanied with severe tinnitus Tonsillectomy was performed ten years before, to obtain improvement in hearing There has been no deafness in the family

Preoperative hearing tests on April 1, 1938, showed, by air conduction, a 42 1/4 per cent loss in the right ear and a 50 1/8 per cent loss in the left ear, by bone conduction hearing was within normal indicated limits

On April 6, 1938, the Lempert operation was performed on the right ear

A postoperative hearing test (air conduction) on April 25, 1938, showed a 27 per cent loss in the right ear and a 46 $\frac{3}{4}$  per cent loss in the left ear

Comment The improvement in hearing was marked immediately after operation and has continued since then On May 14, 1938, a fistula test gave strongly positive results The gain in hearing had been maintained

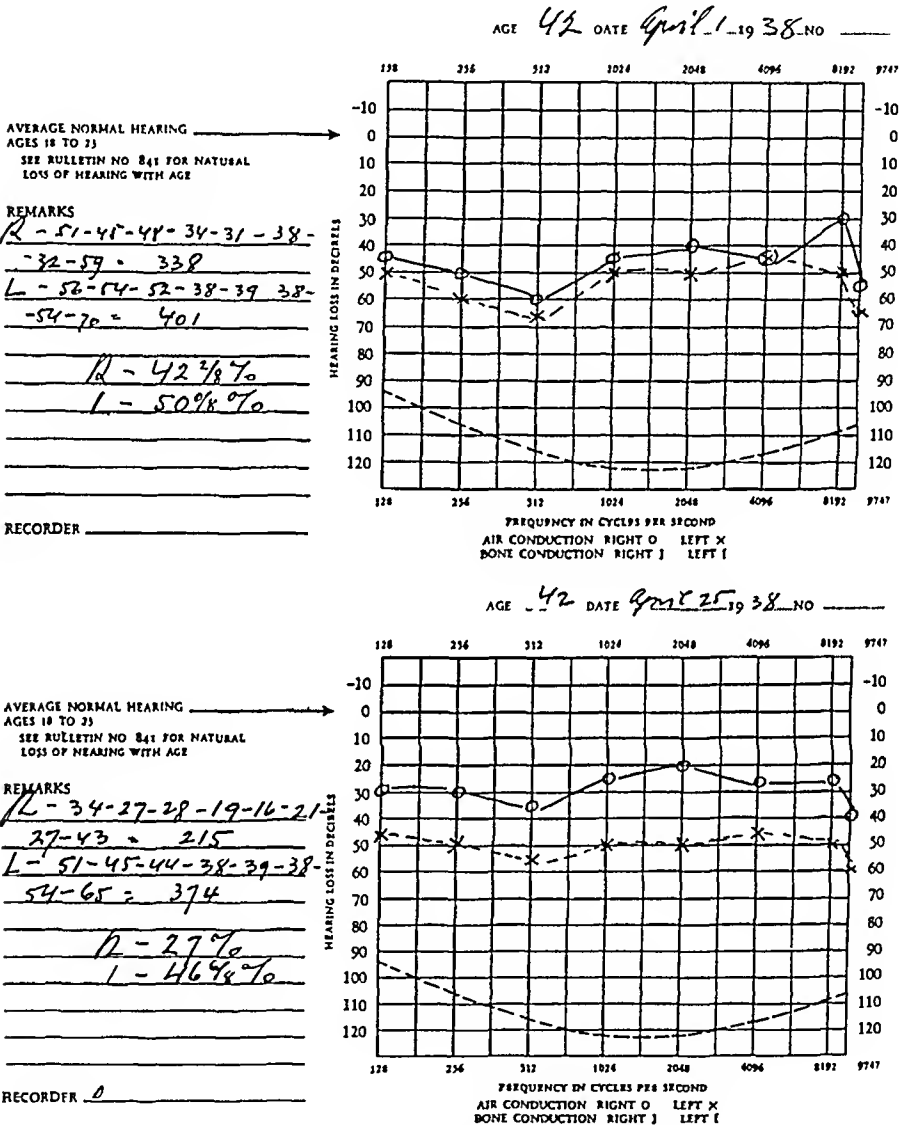


Fig 43 (case 20) —Audiograms of woman aged 42

CASE 21—A woman aged 29, a housewife, had first noticed hardness of hearing six years before examination, after childbirth Her mother had experienced a similar onset of deafness There was intermittent tinnitus The patient had had tonsillitis in childhood and pneumonia at the age of 12 years In the last year she had had vertigo in the mornings

Preoperative hearing tests on April 5, 1938, showed, by air conduction, a 52 $\frac{3}{8}$  per cent loss in the right ear and a 59 per cent loss in the left ear, by bone conduction hearing was slightly below the normal limits

On April 7, 1938, the Lempert operation was performed on the right ear. A postoperative hearing test (air conduction) on April 25, 1938, showed a 33½ per cent loss in the right ear and a 54½ per cent loss in the left ear.

Comment The fistula was open and there was good functional hearing. On May 14, 1938, a fistula test gave strongly positive results, the improvement in hearing had been maintained.

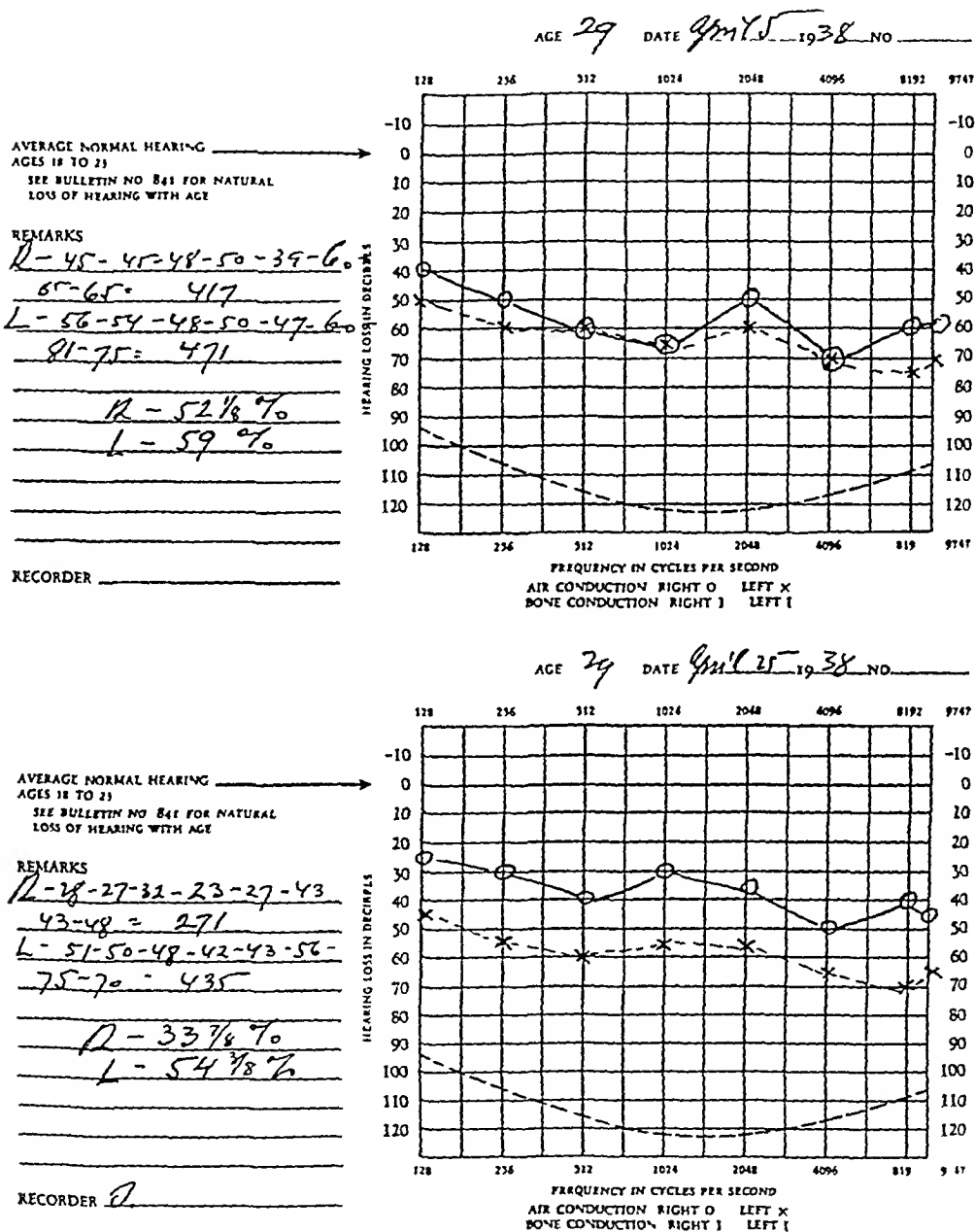


Fig 44 (case 21) —Audiograms of woman aged 29

CASE 22—A man aged 24, a salesman, had been hard of hearing since birth, the right ear being worse than the left. He had had an abscess in the left ear at the age of 1 year. Hearing had become progressively worse in the last two years. Tinnitus was marked in both ears. His father and mother were both hard of hearing.



Preoperative hearing tests on March 19, 1938, showed, by air conduction, a  $58\frac{1}{4}$  per cent loss in the right ear and a  $51\frac{3}{4}$  per cent loss in the left ear, by bone conduction hearing was below the normal indicated limits, that of only two pitches (512 and 1024 double vibrations) within the conversational range being within normal limits (determined by masking)

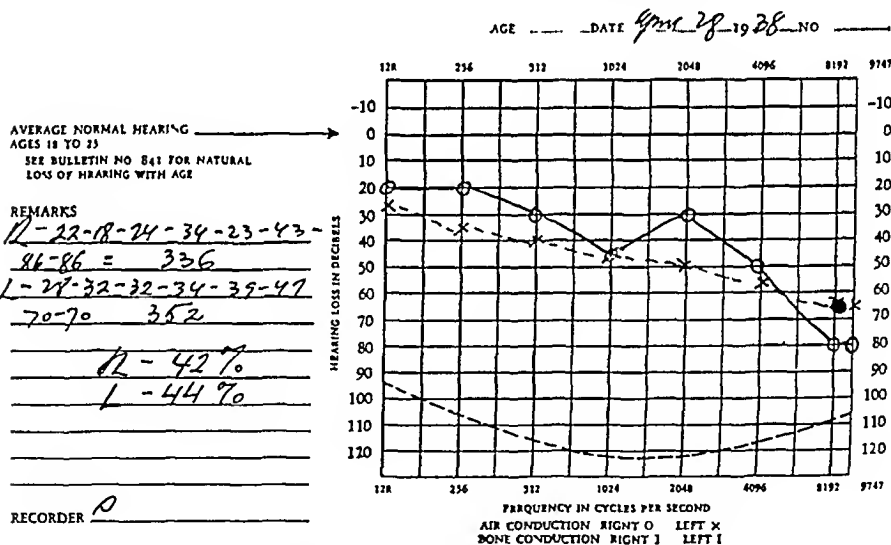
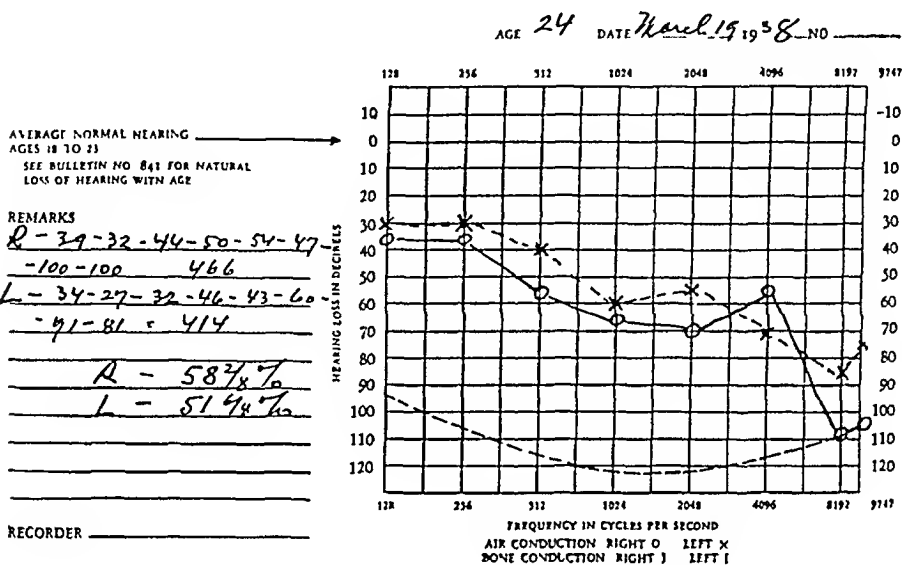


Fig 45 (case 22) —Audiograms of man aged 24

On April 14, 1938, the Lempert operation was performed on the right ear. A postoperative hearing test (air conduction) on April 28, 1938, showed a 42 per cent loss in the right ear and a 44 per cent loss in the left ear.

Comment: Improvement in hearing at the time of operation was marked, the fistula was open. On May 14, 1938, a fistula test gave strongly positive results. The gain in hearing had been maintained.

CASE 23—A man aged 37, a lawyer, had been hard of hearing for twelve years. He stated that the onset of deafness had followed diving and complained of tinnitus in both ears. He wore a hearing aid over the left ear. His mother and a maternal aunt and uncle were hard of hearing.

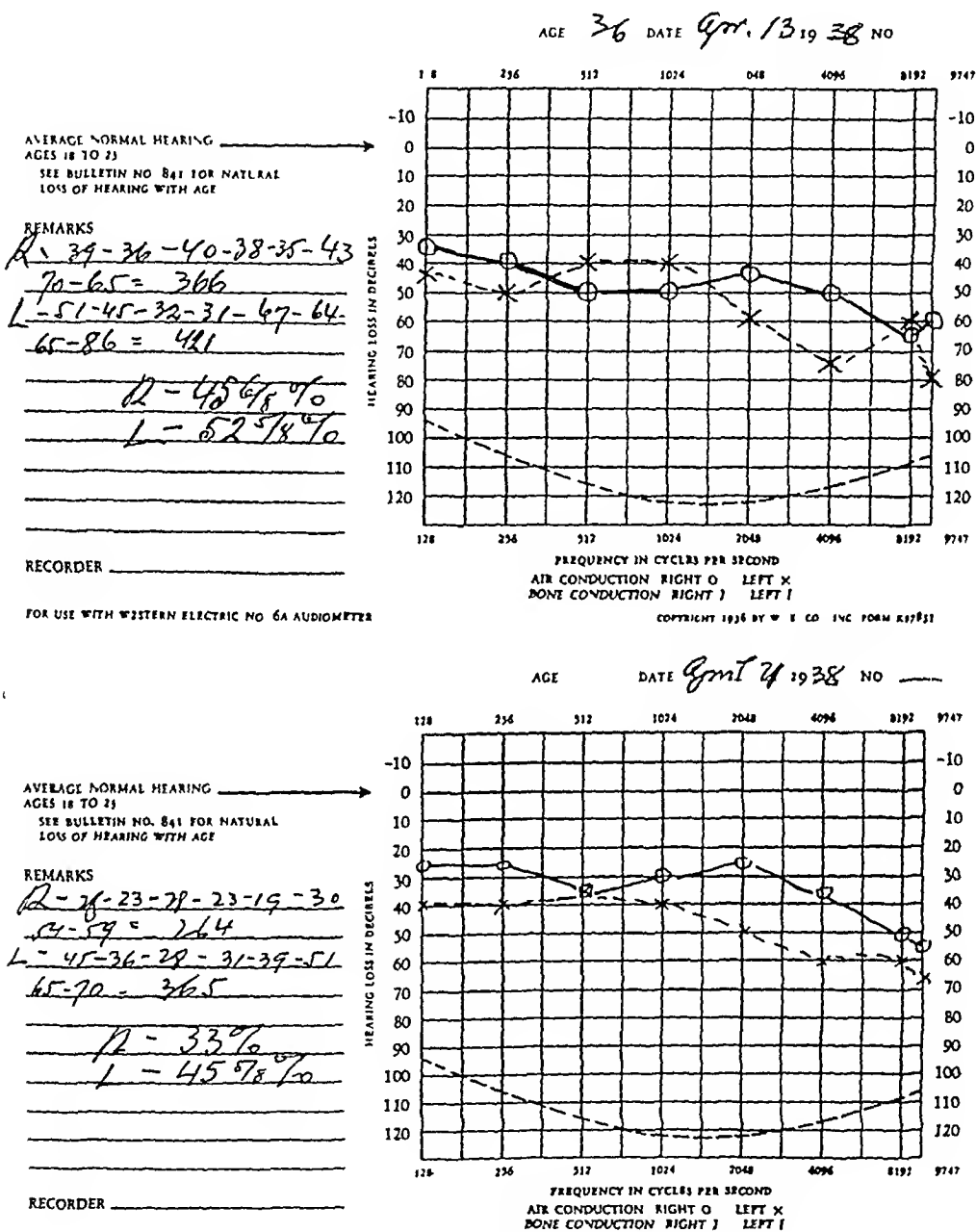


Fig 46 (case 23)—Audiograms of man aged 37

Preoperative hearing tests on April 13, 1938, showed, by air conduction, a loss of 45% per cent in the right ear and of 52% per cent in the left ear, by bone conduction hearing was within normal indicated limits.

On April 14, 1938, the Lempert operation was performed on the right ear.

Postoperative hearing tests (air conduction) on April 21, 1938, showed a 33 per cent loss in the right ear and a 45% per cent loss in the left ear.

Comment The patient discarded his hearing aid and was able to hear normal conversation. On May 14, 1938, a fistula test gave strongly positive results. The improvement in hearing had been maintained.

## CONCLUSIONS

A new technic for the improvement of hearing of patients with otosclerosis is offered. It is a delicate, highly technical surgical procedure designed to create a fenestra in the bony capsule of the external semicircular canal and to provide a mechanical means of keeping this newly created fenestra permanently open. To obtain the desired results it is essential that every step in this technic be patiently and skilfully executed in its minutest detail. To bring this operative procedure to a successful conclusion it is absolutely essential that every surgical step be performed in the exact order described. Each step in this technic is the foundation for the next step, and unless each step is concluded successfully, the next step and therefore the rest of the operation are doomed to failure. This surgical technic should not be attempted by any young otologist unless he is especially trained for surgical measures of this type. Any otologist with a keen knowledge and understanding of the minutest details in the anatomy of the temporal bone, resulting from a large and varied personal experience in operations on it, will master this technic without any difficulty after seeing it carried out.

The endaural, antauricular approach to the temporal bone is employed for the following reasons:

- 1 The tympanomeatal cutaneous membrane which I have described can be obtained only when the endaural, antauricular approach to the temporal bone is employed.

- 2 To avoid the risk of postoperative infection, in addition to applying the strictest rules of asepsis, it is necessary to limit the surgical attack to the tissues directly concerned and thus reach the objective with the least amount of sacrifice of tissue. This is best accomplished by employing the endaural, antauricular approach.

- 3 Better visibility and accessibility of the desired surgical field are obtained by this approach.

- 4 The employment of the endaural, antauricular approach is followed by a convalescence involving the least possible social and economic inconvenience to the patient.

- 5 Cosmetically, the endaural, antauricular approach results in a status as near as possible to that preceding the operation.

I have operated on 23 patients with otosclerosis by the described technic. In 19 cases a good practical improvement in hearing was obtained and maintained. In 4 cases in which operation was performed in spite of poor existing bone conduction, no improvement in hearing was obtained.

This surgical technic was carried out and all the postoperative dressings made under the strictest rules of asepsis. In no case was there a

postoperative infection of the tympanic cavity, the mastoid cavity or the labyrinth

Of the 23 patients operated on the newly created fistula in the external semicircular canal remained open in 22. In 1 case the fistula began to show signs of closure at the end of ten days and was completely closed at the end of three weeks. I believe that in the 22 patients in whom the fistula remained open it will remain permanently open. My previous experience has shown that when regeneration of bone takes place in a newly created fistula, it does so immediately, and clinical evidence substantiating this fact may be observed after the first deep dressing. At the time of each dressing the response to the fistula test becomes less marked, until about four weeks postoperatively, when the fistula test gives a completely negative result. When regeneration of bone does not take place the response to the fistula test continues to remain strongly positive, showing no signs of decreasing intensity.

I believe that it is reasonable to assume that a fistula which has not shown signs of beginning regeneration of bone after two months will remain permanently open.

## NASAL ALLERGY

ALBERT H ROWE, M D

SAN FRANCISCO

"Nasal allergy," as a term, will probably replace many of the former terms, such as "hay fever," "vasomotor rhinitis," "hyperesthetic rhinitis," "paroxysmal rhinorrhea," "nasal neurosis," "nasal hydiorrhea," "catarrhal rhinitis," "spasmodic coryza" and "perennial hay fever." Various ingestant and inhalant allergens and in a few cases bacterial allergens are proving to be the causes of the syndrome which has inspired this terminology in the past. During the last twenty years, however, an increasing number of patients with these nasal symptoms have responded to thorough study and adequate treatment utilizing the ever widening knowledge of allergy and its causes. At present a comparatively small group of these sufferers remains whose symptoms resist allergic therapy. For a condition presenting such symptoms, the term "vasomotor rhinitis" may be appropriate, but no condition should be thus classified without thorough allergic diagnosis and treatment, and the classification, even then, does not remove the challenge to a continued search for possible sensitizations which have eluded discovery by the allergist.

### NASAL ALLERGY

*Etiology*—Seasonal Nasal Allergy<sup>1</sup> It is now recognized that this condition is usually due to pollens, though spores of fungi, seasonal and occupational dusts, and other inhalants, independently or together with pollen, may also cause symptoms, as may certain foods.

Perennial Nasal Allergy This form, causing constant or intermittent symptoms, is usually due to inhalants, such as animal emanations, orris, pyrethrum, occupational or house dusts and fungi. It is also frequently due to food. Pollens which are in the air of certain areas, such as San Francisco, throughout the year or in house dust, having settled there during the pollen season, at times cause perennial symptoms, with exaggeration during the periods of pollination. Inhalant allergy results in sneezing, in watery or mucoid discharge and especially in itching of the nose, the eyes and often the throat and ears. Headaches, nasal occlusion, aching in the region of the antrums, difficulty

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1 Rowe, A. H. *Clinical Allergy: Manifestations, Diagnosis and Treatment*, Philadelphia, Lea & Febiger, 1937.

with hearing and pharyngeal congestion, productive of hacking and clearing the throat, often arise. In food allergy<sup>1</sup> the occlusion may be worse and loss of the sense of smell more frequent. Sneezing may vary in degree, and itching is usually absent when the condition is due to food allergy.

**Nasal Allergy in Children**<sup>2</sup> This is very common. It produces congestion, nasal blocking, sneezing, itching, mouth breathing, clearing of the throat, hacking, snorting, noisy breathing, pushing, picking and rubbing the nose and restless sleep. Itching is usually absent in cases of food allergy. Bacterial allergy as a primary cause of such symptoms rarely occurs, and the infrequency of complicating sinusitis in children is striking. Differentiation of nasal allergy and nasal infection,<sup>3</sup> which produces a red rather than a pale, boggy mucosa and polymorphonuclear white cells rather than eosinophils in the nasal secretions, is most important. The frequency with which in children attacks of nasal allergy and especially of asthma are initiated by sneezing, coryza and allergic nasal congestion, which suggest an infectious cold, has led to the erroneous idea that infections cause such attacks.

*Clinical Picture*—Nasal allergy produces a pale, edematous mucosa of varying redness. Redness increases when active infection is present. Occlusion may be severe, since the tissue is of a loose, erectile type. With continued swelling, the mucous membrane thickens, and polypoid degeneration may result, owing to outpouching of the membrane caused by closure of the glandular orifices. Such chronic allergy is one of the common causes of hyperplastic rhinitis, even in the ethmoid sinuses, according to Hansel.<sup>3</sup> Allergic edema is usually greatest on the lower edge of the middle turbinated bone, in the middle meatus, at times on the anterior edge of the inferior turbinated bone, and over the tubercle of the septum. These areas lie in the so-called respiratory zone of the nose. In the quiescent periods the membrane may resume its normal appearance. Microscopically, eosinophilic infiltration of the tunica propria and other layers of the mucosa, hyalinization and thickening of the basement membrane, round cell infiltration of the connective tissue and dilatation and compression of blood vessels are observed. Similar changes, especially thickening of the membrane and cystic or polypoid degeneration, may exist in the sinuses together with those in the nasal sinuses or independently.

2 Rowe, A. H. Nasal and Bronchial Allergy in Childhood, Arch. Otolaryng. 21: 653 (June) 1935.

3 Hansel, F. K. Allergy of the Nose and Paranasal Sinuses. A Monograph on the Subject of Allergy as Related to Otolaryngology, St. Louis, C. V. Mosby Company, 1936.

It is important to realize that both infection and allergy may produce acute or chronic rhinitis, sinusitis, pharyngitis, tracheitis, bronchitis or laryngitis. The absence of fever and malaise, the presence of a red rather than a pale, boggy nasal mucosa, the history of the symptoms and, particularly, the presence of eosinophils with comparatively few polymorphonuclear cells in the nasal mucus favor a diagnosis of allergy. In the differential diagnosis the value of cytologic examination of the nasal secretions must be stressed, and will be discussed later. The mistake must not be made of treating nasal symptoms arising from infected sinuses, especially the antrums, and from apical abscesses of the teeth with allergic measures.

*Diagnosis*—The diagnosis of seasonal (acute) and perennial (chronic) nasal allergy depends on several factors. The history, particularly of sneezing, nasal blocking and watery or mucoid discharge, with or without itching, especially in the mornings, always should suggest allergy. The presence of other allergic disturbances in the patient or in his progenitors is important. The pale, edematous membrane, with or without polyps, indicates the presence of allergy. Positive cutaneous reactions offer helpful evidence, though in the presence of active allergy, especially to foods, negative reactions frequently occur. In these cases intranasal or conjunctival inhalations of specific allergens may result in sneezing, itching and watery discharge, indicative of mucosal allergy. Dean, Linton and Linton<sup>4</sup> obtained positive results from scratch and intramucosal tests on the mucous membranes with the allergens wheat, milk and eggs when the cutaneous reactions were negative. Roentgenograms of the sinuses may reveal thickened membranes, polypoid degeneration or varying opacity. The study of such mucosal swellings can be made with instillations of iodized poppyseed oil. This seems necessary only in selected cases and is contraindicated if iodine allergy is demonstrated by the ingestion of potassium iodide for a day or two. The transient edema in the antral mucosa from the temporary effect of an allergen must be remembered. It is also recognized that these roentgenologic findings may arise from either infection or allergy and that they may indicate past difficulty which has been controlled. Without the results of allergic therapy based on careful and thorough allergic investigations having been ascertained, such roentgenologic findings should never form the sole basis for surgical intervention. In fact, the diagnosis of allergy usually cannot be certain until the results of therapy conducted for at least several weeks are determined. In other words, the final diagnosis usually must depend

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4 Dean, L. W., Linton, L. D., and Linton, C. S. An Intramucosal Test for Hypersensitivity in Allergic Rhinitis, *Ann Otol, Rhin & Laryng* **44** 317, 1935

on the therapeutic test. Finally the cytologic study of the nasal secretions<sup>5</sup> offers important evidence in determining whether the condition is allergy or infection. Smears of nasal secretions are stained with Wright's stain or preferably with Giemsa's stain. The patient may blow into a piece of cellophane and later the clumps of mucus may be smeared on slides or the mucus may be obtained on a tightly wound cotton applicator. Watery secretion is not especially suitable. Clumps of eosinophils indicate the presence of allergy and the absence of these cells in smears on several days is necessary to rule out a diagnosis of allergy. The relative number of eosinophil or of polymorphonuclear cells indicates the relative amount of allergy or of infection present. If allergy is indicated careful studies must be conducted in order to find the specific allelgenic causes. Eosinophils in the nasal secretions come from the infiltration of the nasal mucosa with these cells. Their presence in the sputum of persons with asthma and in the secretions from the eyes, intestine and vagina when these tissues are the seat of allergic disturbances is common knowledge. Eosinophils in the nasal secretions probably indicate inhalant or ingestant allergy. Cooke<sup>6</sup> also reported finding them in cases of bacterial allergy.

*Treatment*—The treatment of nasal allergy needs special discussion. When inhalant allelgens cause acute or chronic symptoms, hyposensitization with antigens containing all the specific important allergens, whether they are pollens, animal emanations, orris, pyrethrum, cottonseed, kapok, fungi, dusts, silk or any of a number of others, is necessary. Care not to exaggerate the symptoms by giving too large or too frequent doses and sufficiently prolonged therapy, often over a period of from one to three years, are usually necessary. At times elimination of the inhalants makes hyposensitization unnecessary. Environmental control and when pollen allergy is present the use of an air filter are frequently important. The frequency of kapok and cottonseed allergy, particularly from old mattresses and upholstery, has been recognized especially by Rackemann. Thus, dustproof covers on mattresses and pillows are often desirable. When food allergy is suspected, elimination diets<sup>7</sup> which exclude foods commonly productive of allergy are usually valuable, not only for diagnosis but also for treatment. Cutaneous tests infrequently show all the foods to which allergy exists<sup>7</sup> and positive reactions to tests with nonallergenic foods, especially the

5 Hansel, F. K. Observations on Cytology of Secretions in Allergy of Nose and Paranasal Sinuses, *J. Allergy* 5: 357, 1934.

6 Cooke, R. A. Infective Asthma: Indication of Its Allergic Nature. *Am. J. M. Sc.* 183: 309, 1932.

7 Rowe, A. H. The Evaluation of Skin Reactions in Food Sensitive Patients. *J. Allergy* 5: 135, 1934.



intra-dermal test, are not uncommon. With control of symptoms, a gradual enlargement of the diet is made according to the symptomatic response to foods which are included. Exclusion of drugs, such as acetylsalicylic acid, which occasionally produce nasal allergy is necessary when the patient is allergic to them. The combination of food and inhalant sensitizations, especially in cases of perennial allergy, must be recognized. In all this treatment, absolute cooperation of the patient over a long period is necessary to obtain satisfactory results and to control the effects of heretofore unrecognized allergenic influences, as well as the effects of changes in seasons and weather. The allergist must act as the policeman to hold the patient to all necessary restrictions and precautions.

**Indications for Surgical Therapy** In cases of nasal allergy surgical therapy is indicated when there is actual nasal obstruction which is not due to allergic edema. This is especially true in cases of polyp and of cystic or polypoid degeneration of the turbinated bones. Definite infection in the sinuses, particularly the antrums, and especially from apical infection of a tooth, must be dealt with surgically. Usually, except in cases of acute infection, operation should be performed only after allergic study and therapy have been carried out. With the full cooperation of an allergist, the rhinologist can usually obtain better results, and much surgical treatment which seemed necessary in past years can now be avoided. If it is remembered that in most cases nasal blocking associated with so-called vasomotor rhinitis is due to allergy and proper allergic therapy is instituted, the patient can usually be spared subjection to shrinkings and intranasal treatment. Long-standing nasal allergy, however, as has been stated, produces structural changes, irreversible in type, which are greatly benefited by surgical treatment after allergic treatment is well established. This opinion is held by most allergists and by an increasing number of rhinologists. Hansel<sup>5</sup> recently stated that he found it advisable to do various intranasal and sinus operations in only 25 of 220 cases of nasal allergy.

The same attitude toward surgical intervention on the nose and sinuses in treatment of bronchial asthma is increasingly evident. My experience<sup>1</sup> agrees with that of Hansel,<sup>3</sup> Vaughan<sup>8</sup> and most other allergists in that operation on the sinuses has failed, except in isolated instances, to relieve bronchial asthma. The favorable results in certain reports have not been checked by sufficiently prolonged follow-ups, and the effect of nonspecific hyposensitization and of the absorption of injured and necrotic tissue has received little consideration. When inhalant and ingestant allergens are adequately considered in the treat-

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<sup>8</sup> Vaughan, W. T. *Allergy and Applied Immunology*, ed 2, St. Louis, C. V. Mosby Company, 1934.

ment of bronchial asthma, good results are the rule. The exception is found in patients with long-standing asthma, especially when they have undergone many operations on the nose and sinuses. Even in many of these cases acceptable, and even excellent, results arise from allergic control. In treatment of both nasal and bronchial allergy, tonsils and adenoids should be removed only with the object of eradicating infection. Benefit to the allergic symptoms rarely occurs as a result of these operations, and many instances of the precipitation of potential nasal allergy and especially of bronchial asthma<sup>1</sup> after tonsillectomy have been reported in the literature. Of interest is the fact that decreased susceptibility to colds and to respiratory infections from the nonspecific effect of pollen or other antigenic therapy has been reported by Steinberg, Cooke, Van der Veen and Hansel and has also been observed in my own practice.

**Cauterization of the Nasal Mucosa.** This procedure has been recommended for fifty years or more in cases of what is now recognized as nasal allergy and bronchial asthma. Various physicians have used trichloroacetic acid, silver nitrate, phenol and alcohol,<sup>1</sup> and in a limited number of cases varying degrees of relief have been obtained. It seems to be of special value in the cases in which the sphenopalatine ganglions and their mucosal ramifications are in a highly irritable state so that irritating inhalations, changes in temperature or nervous states produce nasal symptoms. Its greatest value is in the cases of so-called vasomotor rhinitis in which the patients fail to receive satisfactory relief from allergic therapy. In such cases, however, the relief obtained by cauterization is usually temporary, and the challenge to continued allergic study and treatment persists.

In recent years much publicity has been given to cauterization of the nasal mucosa and to ionization with zinc, copper and other mineral solutions. The remarkable results claimed for such ionization encouraged its use by many physicians. However, no better results are obtained than with simpler methods, the discomfort after ionization is usually great, and complicating infections of the sinuses have been reported. All this, added to the cost of the machines generally advised, points to a speedy decrease in the use of ionization. It has been of varying help in cases of vasomotor rhinitis, but in this condition local cauterization is to be preferred.

#### OTHER ALLERGIC SYMPTOMS

Brief mention will be made of other symptoms arising from allergy which may be of interest to the specialist in diseases of the nose and throat. Duke<sup>9</sup> reported cases of dizziness and the typical Ménière's

<sup>9</sup> Duke, W. W. Ménière's Syndrome Caused by Allergy, *J. A. M. A.* 81: 2179 (Dec. 29) 1923.

syndrome due to inhalant allergy. Since then, Balyeat, Malone, Yandell, Levy, Wildei, Proetz, Urbach and I<sup>1</sup> have observed similar cases, and such symptoms have been recorded. Allergic edema in the internal ear, its nerve tracts or its centers in the brain is probably responsible. The relief obtained by the use of Furstenberg's<sup>10</sup> diet suggests edema as the cause. The frequency of allergy in patients with Ménière's disease remains to be determined. Impairment in hearing from edema in the eustachian tubes or the middle ear, or even in or around the auditory nerves, may arise from allergy, especially in association with recurrent or chronic nasal allergy. To what extent allergy causes ringing and noises in the ears is uncertain. Evidence points to the frequency of otitis media in children afflicted with nasal allergy. With allergic control, the use of autogenous vaccines and the removal of infected tonsils and adenoids, the frequency of this complication is diminished in allergic patients. Dermatitis in the auditory canals, on the lobe of the ear and behind the ear may arise from allergy due to foods and inhalants. This may be a localized lesion or may be associated with eczema in other cutaneous areas. Contact allergy and infection from fungi or bacteria may also cause aural dermatitis.

Allergy as a major cause of migraine and of recurrent headache and neuralgia has been reported by Vaughan,<sup>5</sup> Balyeat,<sup>11</sup> Rinkel and Eyer-mann, and this claim is supported by my own studies. Edema of localized areas of the meninges or of the nerve sheaths best explains such pain. It is important to rule out other recognized causes, such as ocular disturbances, infection of the sinuses and certain toxic conditions. The fact that allergic migraine may be associated with ocular symptoms and that allergic edema of the nose at times accompanies such headaches has led to much ocular and nasal therapy without any resulting benefit. Allergy to foods and at times to inhalants is the common cause of migraine.

In the oral cavity, food allergy and at times drug sensitizations are productive of canker sores and of soreness and inflammation of the tongue, gums and oral mucosa. Allergic pharyngitis, gingivitis and a tendency to recurrent herpes of the lips occur. The frequency of angioneurotic edema of the lips, face, tongue and pharynx and its possible fatality when it occurs in the larynx are generally appreciated. Urticaria of the pharynx, larynx, trachea and esophagus, as recorded by Jackson, may arise. Coated tongue and heavy breath, due to interference with peristalsis, burning, stinging sensations and a bitter, metal-

10 Furstenberg, A. C., Lashmet, F. H., and Lathrop, F. Ménière's Symptom Complex. Medical Treatment, *Ann. Otol., Rhin. & Laryng.* **43** 1035, 1934.

11 Balyeat, R. M. Migraine. Diagnosis and Treatment, Philadelphia, J. B. Lippincott Company, 1933.

lic taste in the mouth, afflict some patients with gastrointestinal allergy. A severe result of drug allergy has been recognized in agranulocytic angina, which probably is fundamentally due to sensitization in the cells of the bone marrow. Allergic purpura due to food or drug sensitizations arising from allergy in the bone marrow, or possibly in the platelets themselves, may produce hemorrhages of the mucous membrane. It is also probable that unusual nasal bleeding arises from increased capillary permeability due to an underlying allergy. Finally, recurrent swellings of the salivary glands, especially of the parotids, arising from allergy, have been observed in my work<sup>1</sup> and recorded in the literature. All these possible manifestations of allergy stress the necessity for its constant consideration in practice.

#### CONCLUSIONS

1 Nasal allergy is responsible in practically all cases for so-called hay fever, vasomotor rhinitis, paroxysmal rhinorrhea, nasal neurosis, spasmodic coryza and perennial hay fever.

2 Vasomotor rhinitis which does not respond to careful and adequate allergic diagnosis and therapy may be due to unrecognized or undiscovered allergens or to other factors unknown.

3 When nasal allergy is suspected, examination of the mucus for eosinophils should be a part of the routine.

4 Surgical intervention in patients with nasal allergy should be resorted to only to remove obstructions not due to allergic edema or to control actual infection. Adequate allergic study and treatment for several weeks or longer should precede such intervention.

5 Ionization of the nasal mucosa should be discouraged.

6 The frequency of allergy as a cause of migraine, recurrent headaches, dermatitis of the auditory canals, canker sores and, occasionally, recurrent dizziness must be remembered.

# USE OF THE HYOID BONE AS A GRAFT IN LARYNGEAL STENOSIS

EDWARD A. LOOPER, M.D.

BALTIMORE

The whole subject of laryngeal stenosis is a complicated one. Each case requires individual study, and particular problems in treatment must be dealt with to obtain a cure. At best, the condition is tedious and difficult, often requiring treatment over a long period—from months to years. Even then, the final result may not be as good as desired.

For many years the greatest number of the patients have been children, the condition arising secondary to improperly performed tracheotomies, as has been so often emphasized by Dr. Chevalier Jackson. Through his efforts, surgeons have been gradually instructed in the proper method of performing a low tracheotomy, and the disease is fortunately becoming more rare.

Another factor which has contributed greatly to the decrease in the incidence has been the advancement in the treatment of laryngeal diphtheria. The brilliant results of prophylactic treatment of this disease with toxoid, the great interest shown by state health departments in the control of diphtheria and the establishment of modern quarantine hospitals, with staffs trained to administer large doses of antitoxin intravenously when necessary in cases of severe involvement, have been among the outstanding triumphs of modern preventive medicine. In such hospitals, when serious laryngeal involvement develops a successful intubation can be quickly performed, obviating the necessity of a tracheotomy, with its possible disastrous after-effects of laryngeal stenosis. So members of the medical profession can look to the future with assurance that this complicated condition will occur less and less frequently.

However, with the desire for fast transportation in airplanes, with the use of millions of automobiles and other conveyances, accidents are proportionately increasing. Injuries to the larynx are common. Lacerations are often deep, with resulting deformity and stenosis. Consequently, cases of this type have now become one of the most important problems in treatment.

In June 1937 a patient was sent to the hospital with a history of having sustained a severe injury to his larynx in a railroad accident. On admission to the hospital, the patient was wearing a tracheotomy.

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tube and was suffering with a badly lacerated larynx. In planning his treatment, I could see clearly that some sort of graft would be helpful in this particular case. The thought occurred to me that it might be possible to make some use of the hyoid bone as a graft in such a condition. So, after experimenting on a cadaver, I performed successfully the operation presently to be described. The patient's convalescence was greatly shortened, and a satisfactory airway was established more quickly than had been expected.

Since that time this procedure has been used on other patients with results which have made me feel that it is an operation worthy of reporting, even though it is a new method of treatment in the preliminary stages of development.

This operation would seem to be best adapted to the treatment of trauma to the larynx in adults. It has not been tried in children and in its present state is not suggested for their cases.

#### OPERATION

*Anesthesia*—After using tribromethanol (aveitin) to induce anesthesia for a number of years, I have found it a most satisfactory basal anesthetic for surgical intervention in the larynx. The patient goes to sleep quietly without excitement, his blood pressure is lowered, he breathes more slowly and sleeps for a longer period of time. Rectal administration of the drug keeps the anesthetist out of the way of the operation and avoids the irritating action on the respiratory mucosa so common with gaseous anesthetics. It is to be preferred to local anesthesia, as, the patient being unconscious, the operation can proceed more rapidly and there is little shock to the nervous system, a factor of importance in any surgical operation. So I now employ this method as a routine procedure in most of my cases.

*Technic of the Operation*—The surface of the skin of the anterior part of the neck, from the chin above to the sternal notch below, is carefully shaved and cleansed with soap and water. This procedure can be performed in the patient's room if desired. While the patient is going to sleep on the operating table, the surface of the neck is made aseptic with alcohol, ether and iodine or with merthiolate, according to the choice of the operator. The patient is then draped in the usual manner.

As a previous tracheotomy has been necessary, the tracheotomy tube should be removed, any granulation tissue present trimmed away and the raw edges cauterized with 10 per cent solution of silver nitrate. A larger tube is then inserted and tied with tape. The neck is extended and firmly fixed with pillows or small sandbags.

A vertical incision is made in the skin beginning above at a point on a line with the upper margin of the hyoid bone (fig 1). This incision is carried downward about 1 inch (2.5 cm.) to the left of the

midline of the larynx, to the lower end of the thyroid cartilage. By keeping the incision to the left, one obtains a better chance of a good blood supply to the upper surface of the graft, and it can be more securely covered over than it could be if the incised edges were directly in line with the graft. The incision should not be carried as far down as the tracheotomy opening, because it is important to retain an adherent, unbroken bridge of tissue between the laryngeal opening above and the tracheotomy wound below. With this normal area left intact, there is less possibility of contamination and infection above. The tip of the graft will also be better protected and will have a more satisfactory blood supply.

From the upper point of the incision near the center of the hyoid bone, the incision is carried horizontally to the left, on a line with the

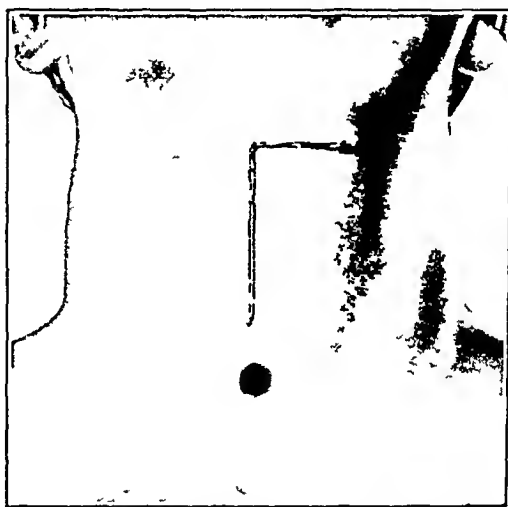


Fig 1—The incision in the skin extends from the lower margin of the thyroid cartilage upward to the center of the hyoid bone and then to its left tip

hyoid bone, to its end. The subcutaneous tissue is separated, and the thyrohyoid muscle is cut across at its upper attachment. The anterior surface of the hyoid bone is then exposed throughout its entire left half. Beginning at the tip, one should free the bone from its posterior attachment with great care, for if a perforation occurs there infection from the pharynx may develop, with serious complications.

In excising this end of the hyoid bone one should make no effort to skeletonize its upper, lower and anterior surface as some adherent soft tissue is advantageous because it gives the graft better blood supply and protection. After being freed and elevated, the end of the bone is made ready to be swung into the desired position in the larynx (fig 2).

The bed for the graft requires particular preparation. A vertical incision is carefully made in the thyroid cartilage down to the mucosal lining, the desired amount of mucous membrane being separated from

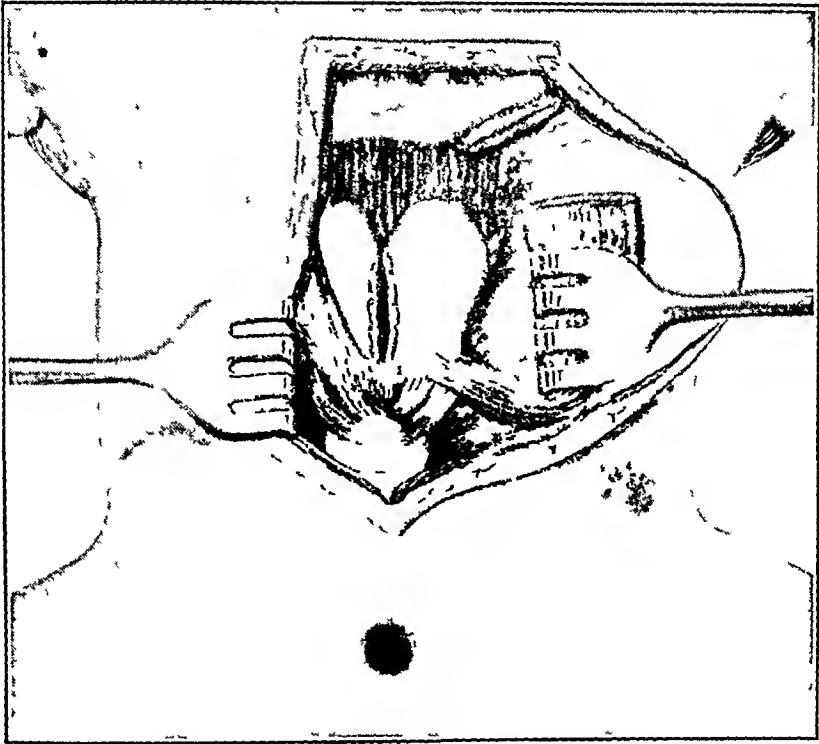


Fig 2—The hyoid bone is exposed, the thyroid cartilage incised and a bed made for the graft

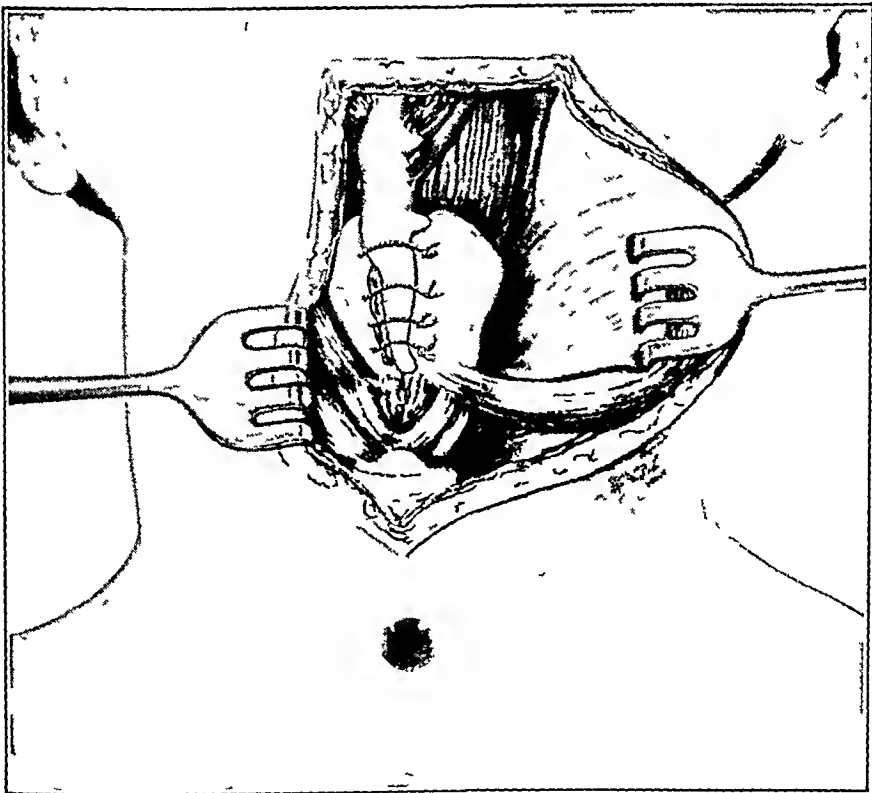


Fig 3—The end of the hyoid bone is rotated and placed between the separated thyroid cartilage



the cartilage by submucous resection and every effort being made to prevent injury to or perforation of the interior of the larynx. Cartilaginous deformities, irregularities and scar tissue, when found, are corrected as much as possible.

The incised edges of the thyroid cartilage are retracted and the end of the hyoid bone is placed between them and securely held in place with chromic catgut sutures (fig 3).

If perforation or infection in the laryngeal area is suspected a small rubber tube drain should be inserted at the lower point of the wound for a few days. If perforation has occurred in the hyoid region a small rubber tube drain should be placed in the left end of the wound.

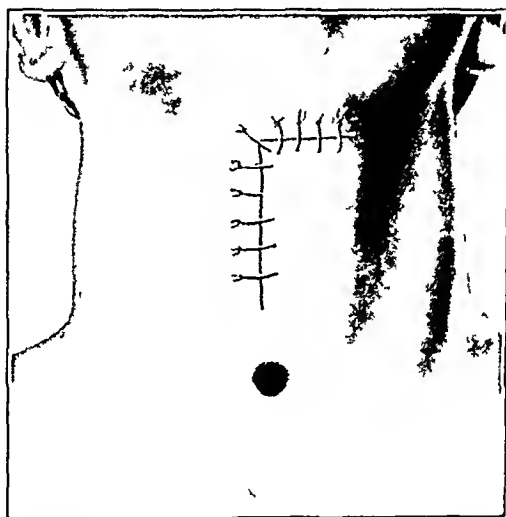


Fig 4—The wound in the skin is closed with fine silk.

The overlying structures are now replaced, bleeding vessels tied off and the skin closed with fine silk. The wound is covered over with rubber tissue and petrolatum gauze (fig 4).

A feeding tube should be inserted, as in laryngectomy, to be retained for about ten days.

#### POSTOPERATIVE TREATMENT

This operation requires the same careful after-treatment as does laryngectomy. A suction machine should always be at the bedside of the patient. The resident should be impressed with the importance of aspirating bronchial exudate to prevent pulmonary complications. The patient's position should be changed frequently so as to lessen the possibility of bronchopneumonia. The wound should be frequently dressed, and if infection has developed more drainage may be required.

If secondary hemorrhage occurs, the bleeding point should be tied off locally if possible. Should bleeding be continuous and severe liga-

tion of the external carotid artery can always be performed with the assurance that the hemorrhage will be controlled

# COMMENT

This operation is proposed as a method of utilizing the hyoid bone as a graft in the treatment of laryngeal stenosis in certain cases

The principle depends on embedding the left end of the attached hyoid bone between the incised thyroid cartilage, to act as a wedge in enlarging contractures and deformities of the larynx and to permit a better airway. This firm bony graft acts as a splint to weakened and deformed cartilage. The ease with which the hyoid bone can be exposed, detached and rotated makes the procedure practical.

A living, attached and accessible graft, with the blood supply to its upper part undisturbed, has advantages over a foreign embedded graft, such as cartilage from a rib, an ear or some other part of the body.

The operation is an improvement for treatment in certain cases of laryngeal stenosis resulting from injury in adults. It is not proposed as a perfect and immediate cure-all for every patient with laryngeal obstruction and has not been tried on children.

104 West Madison Street

# NEW METHOD OF OPERATION FOR CONGENITAL ATRESIA OF THE POSTERIOR NARES

JOSEPH C DONNELLY, DDS, MD

PHILADELPHIA

Congenital atresia, or imperforation, of the posterior nares is a developmental malformation resulting in partial or complete closure of the choanae. The obstruction may be unilateral or bilateral and membranous or osseous. In my case the occlusion was complete and the partition composed of bone. Operation comprised removal of the obstructing plate and insertion of a full thickness skin graft to prevent cicatricial closure.

## PATHOGENESIS AND ANATOMY

Several theories have been advanced to explain this anomaly, which the early writers attributed to an overgrowth of the bony structures surrounding the choanae. Luschka<sup>1</sup> said that the obstructing plate arises from a projection upward and backward of the horizontal plate of the palatal bone, while Kundrat stated that the occlusion follows an extension inward of the vertical plate of the palatine bone. Thomasson<sup>2</sup> expressed the opinion that the atresia is due to an extension of the plate of the vomer which becomes adherent to the lateral nasal wall. These theories, however, do not explain the clinical types of atresia which are membranous. The most accepted hypothesis today and one that might explain both types of choanal obstruction was advanced by Schaeffer<sup>3</sup>. In his explanation he emphasized that choanal atresia is dependent not only on the behavior of the bucconasal membranes and the primitive choanae but on the degree of absorption of the floor of the secondary nasal fossae dorsal to the primitive choanae and the degree of dorsal expansion or growth of the nasal fossae. He stated further that the extent of the resorption of the mesenchymal tissue

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Read before the Section on Otolaryngology of the College of Physicians of Philadelphia, Oct 20, 1937

From the Department of Otolaryngology of the Hospital of the University of Pennsylvania

1 Luschka, H. Ueber angeborene Atresie der Choanen, *Virchows Arch f path Anat* **18** 168, 1860

2 Thomasson, W J. Congenital Bony Occlusion of the Right Nasal Choana, *Laryngoscope* **25** 221 (April) 1915, cited by Grove<sup>10</sup>

3 Schaeffer, J P. Various Types of Congenital Atresias of the Nose and Their Genetic Interpretation, *Tr Am Laryng A* **56** 126, 1934

between the nasal and the pharyngeal epithelium determines whether the atretic mass is to be membranous osseous or both

Facts are lacking to substantiate the hereditary nature of this interesting anomaly, but occasionally it has been shown that a connection exists between congenital choanal occlusion and some congenital defect of the adjacent facial structures. In most of the cases observed by Blair<sup>4</sup> the condition was associated with cleft palate, and when a unilateral cleft existed the choanal atresia was on the opposite side. Vogel<sup>5</sup> recorded a case in which the ala of the nose on the affected side was smaller than its fellow and lateral to it was an opening of a blind fistula. In Thomasson's<sup>2</sup> case there was associated congenital coloboma of



Fig 1—The patient, a 4 year old child. The face appears entirely symmetric, and there was no other congenital defect.

the iris while a double tragus was found on each ear of the infant in Binnerts'<sup>6</sup> case. In my case the facial structures were normal (fig 1). The usual separation of the lips is not revealed in the illustration.

A review of the anatomy of the posterior nares or choanae in the young child, as shown in figure 2 immediately impresses one

4 Blair, V. Congenital Atresia or Obstruction of the Nasal Air Passages. *Ann Otol, Rhin & Laryng* 40 1021 (Dec) 1931.

5 Vogel, K. Rechtsseitige typische Choanalatresie in Verbindung mit verschiedenen angeborenen Hemmungsbildungen des Gesichts. *Ztschr f Hals- Nasen- u Ohrenh* 11 121, 1925.

6 Binnerts, A. Einseitige Choanalatresie bei einem Säugling von drei Monaten. *Arch f Laryng u Rhin* 34 324 1921 cited by Grove<sup>10</sup>

with the small size and the oval shape of the apertures. With the posterior pharyngeal wall removed it may be noted that the roof is formed by the alae of the vomer and the body of the sphenoid bone, while the floor is represented by the line of junction of the hard and the soft palate. The vomer, or posterior edge of the septum, is shown as the medial boundary, and the lateral walls are limited by the medial plates of the pterygoid processes of the sphenoid. The drawing, while a trifle magnified, represents the vertical and the transverse diameters, about 1 cm., of the choanae of a child  $3\frac{1}{2}$  years old, or only six months younger than my patient. It may be stated that the equality of the

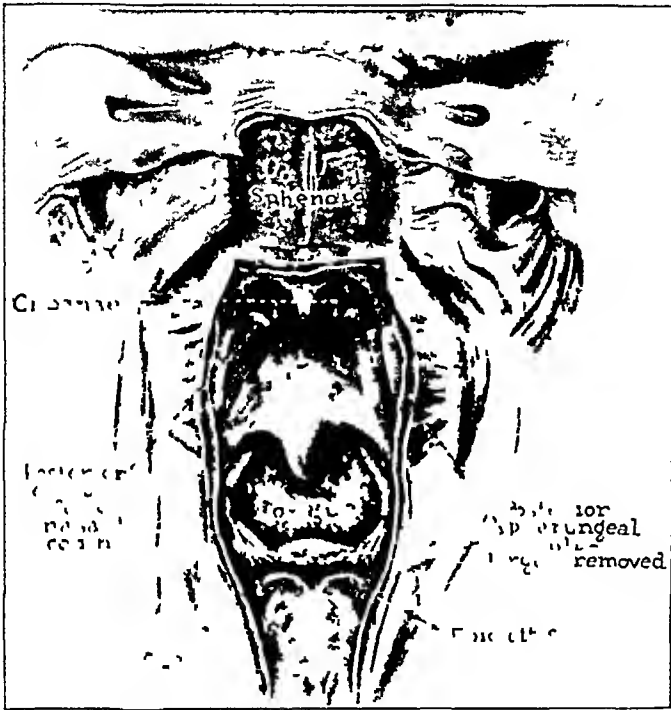


Fig 2—The pharyngeal cavity, exposed from behind, of a child  $3\frac{1}{2}$  years old

diameters is maintained during the first decade of life, and this anatomic fact may be used to advantage in cases of choanal occlusion in which plastic repair is contemplated.

#### HISTORY AND INCIDENCE

Otto,<sup>7</sup> in 1829, while performing a necropsy, was the first to discover congenital choanal obstruction, and almost a quarter of a century passed before the first clinical case, in a boy 7 years of age, was reported by

<sup>7</sup> Otto, A. W. A Compendium of Human and Comparative Anatomy, translated by J. F. South, London: B. Fellowes, 1831.

Emmert In the fifty years following Otto's discovery only 17 cases were recorded in the literature, in 15 of which occlusion was complete. The collection made by Hubbell<sup>7a</sup> showed that in 8 the condition was bilateral and in 7 unilateral. The atresia was bony in 12 and membranous in 5. In twenty-five more years a few more than 100 additional cases were recorded, and these were reviewed by Fraser<sup>8</sup> in 1910. In two thirds the obstruction was unilateral and in 90 per cent bony. This predominance of the osseous type of occlusion over the membranous was substantiated by Lebensohn,<sup>9</sup> who reviewed the case reports in 1923. Four years later Grove<sup>10</sup> estimated that the total number of all cases of choanal atresia did not exceed 180. Since 1927 about 32 cases have been added, which brings the total to date to approximately 212. To recapitulate, approximately 200 cases have been recorded during the last fifty years. Last year 6 case reports were published by Anderson<sup>11</sup>. These represent the total number of cases at the Mayo Clinic during the last thirty years, and it is significant that 5 of them were observed during the last decade. Of the total 32 cases collected since 1927, 14, or nearly one half, were recorded in the past two years. These figures tend to show that atresia of the posterior nares is meeting with more general recognition and that in the near future the incidence will probably be much higher.

#### DIAGNOSIS

The symptoms and the problem of diagnosis of choanal occlusion vary with the type of atresia and the age of the patient. In the newborn the difficulty in breathing becomes alarming if the obstruction is bilateral, but the symptoms of severe dyspnea and cyanosis disappear when the infant begins to cry. With the mouth open oxygenation is reestablished, but the impelling instinct of nasal breathing soon asserts itself, and when the mouth closes there is a repetition of the dyspnea and cyanosis. Richardson<sup>12</sup> referred to the "cyclic" character of this type of dyspnea and commented on the desirability of obstetricians' recognizing it. When the choanal obstruction is present on only one side respiratory embai-

7a Hubbell, A. A. Congenital Occlusion of the Posterior Nares, Buffalo M. & S. J. **26** 5, 1886.

8 Fraser, J. S. Congenital Atresia of the Choanae, Brit. M. J. **2** 1698, 1910.

9 Lebensohn, J. E. Congenital Atresia of Postnasal Orifices, Ann. Otol., Rhin. & Laryng. **32** 1128 (Dec.) 1923.

10 Grove, W. E. Choanal Atresia and Sinus Infection, Arch. Otolaryng. **6** 237 (Sept.) 1927.

11 Anderson, C. M. Congenital Occlusion of the Choana, J. A. M. A. **109** 1788 (Nov. 27) 1937.

12 Richardson, C. W. Congenital Atresia of the Post-Nasal Orifice, Lancet **2** 439 (Aug. 15) 1914.

nessment is not conspicuous but may manifest itself at nursing time. The occasional difficulty in breathing observed during nursing is often attributed to an enlarged thymus, and, though roentgen treatment fails to give relief, further diagnosis is usually not attempted. With the nursing period past the impairment in breathing is no longer noticed and the problem seems solved. Only in childhood or in later years is advice sought for unilateral choanal atresia. In the adult the obstruction to respiration is usually the presenting symptom, and the nasal discharge assumes a secondary role. In young children the reverse is true, and the constant nasal discharge is the predominating sign. Many observers have referred to the characteristics of the nasal secretion when the choanae are occluded. Richardson claimed that the excessive and annoying thick clear albuminous exudate is almost pathognomonic of post-nasal obstruction, while Kirby commented on the peculiar bluish glairy appearance of the secretion. Grove<sup>10</sup> said that in adults the exudate is tenacious and cannot be expelled from the nose. Other prominent findings are atrophy of the turbinate bones with hypertrophy of the overlying mucous membrane, as described by Stewart<sup>13</sup>. The atrophied conchae make the affected nostril appear larger, but this asymmetry is more apparent than real, as was demonstrated in the roentgen studies of Lebensohn.<sup>9</sup> In the young child the mucosal and the bony changes are not so marked and may be overlooked as a diagnostic sign.

The question of diagnosis would be simplified if the possibility of congenital nasal occlusion was kept in mind but one is occasionally off guard and falls into error. The pitfall in the diagnosis arises when the chronic nasal discharge, often green or yellow, is misconstrued as evidence of chronic disease of the paranasal sinuses. This was true in my case and in the case of Grove, in which the roentgenogram showed sinusal abnormality.

The diagnosis may be confirmed by passing a probe through the nose and gently sounding the obstructing wall. Others have used a small rubber bulb syringe or a Politzer bag and carefully forced air through each nasal passage. Roth and Geiger<sup>14</sup> suggested filling the obstructed passage with fluid and watching to see whether it flows to the nasopharynx. For adults and for some children the diagnosis can be confirmed with the nasopharyngoscope but in all cases of bony occlusion asymmetry can perhaps be demonstrated in the roentgen shadows of the choanae, as in my case.

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13 Stewart, J. P. Congenital Atresia of the Posterior Nares, *Arch. Otolaryng.* **13** 570 (April) 1932.

14 Roth, J. H., and Geiger, C. W. Congenital Osseous Occlusion of the Posterior Choanae. *Ann. Otol. Rhin. & Laryng.* **35** 849 (Sept.) 1926, cited by Colver.<sup>19</sup>

## OPERATIVE PROCEDURES

The surgical relief of congenital atresia has been the accepted method of procedure ever since Emmert in 1853 operated on the first patient a boy of 7 years. A curved trocar was used to break down the occluding wall and this technic was probably followed until 1885, when von Schrotter<sup>15</sup> began employing the galvanocautery. His patient a girl of 19 had bilateral osseous atresia and was operated on successfully with a burr and cautery. During the following years many types of trephines and drills driven by electric motors were devised to cut through the bony plate along the line of attachment to the vomer. Then a different method of approach by way of the nasal septum, was advocated by Uffenorde<sup>16</sup>. His operation consisted in raising the mucoperiosteum of the septum down to the obstructing plate from the anterior surface of which the mucoperiosteum was separated until the outer border of attachment was reached. The flap was thrown outward and the bony obstruction removed by chisel and curet. The flap was then replaced and an incision was made vertically through it as it covered the nasal surface of the obstruction. After an expanding forceps was introduced through the incision the redundant mucoperiosteal flap was made to fit and to cover the whole margin of the wound in the bone. This method had some popularity and Richardson thought it ideal. Later surgeons, however, discarded it because of the difficulty in carrying the mucoperiosteal flap over the surface of the obstruction. Stewart in 1931 found it exceptionally difficult to perform in a child of 15, and after 2 of his 3 operations he noticed that he had made the choanal opening in the posterior part of the septum while the obstructing plates were left in situ.

The operation of choice today consists in removing the obstructing wall and then taking away the posterior part of the vomer. White<sup>17</sup> found this method practicable after an unsuccessful experience with the Uffenorde technic. In 1918 he described the operation only to find out later that a similar procedure had been recommended a few years before by Katz<sup>18</sup> and associates.

15 von Schrotter L. Ueber angeborenen knöchernen Verschluss der Choanen, *Monatschr f Ohrenh* 19:97 (April) 1885 cited by Colver<sup>19</sup>

16 Uffenorde, W. Ein Fall von Choanalatresie mit Demonstration, *Ztschr f Laryng, Rhin* 1:475, 1908

17 White, L. E. Occlusion of the Posterior Nares *Laryngoscope* 28:571 (Aug) 1918

18 Katz L. Preysing H. and Blumenfeld F. *Handbuch der speziellen Chirurgie des Ohres und der oberen Luftwege* Würzburg: Curt Kabitzsch 1911-1913 vol 3 p 432, cited by Colver<sup>19</sup>



During the past twenty years this method has met with varied success, as the more detailed and instructive reports testify to the perplexities of maintaining a choanal opening. One of Colver's<sup>19</sup> patients was an infant only 6 days old with bilateral osseous atresia. The surgical procedure comprised reaming the choanae to normal size and then with a small rongeur forceps removing a portion of the vomer. Small pieces of rubber tubing were then introduced into the nostrils and left in place for a few days. Observation a few months later showed the right choanal opening apparently normal while the left side was somewhat stenosed. A secondary operation was contemplated. One might infer that the problem of preventing cicatricial stenosis is less difficult in the older child and the adult, in whom a larger choanal orifice is to be found. It appears, however, that this is not the case. Kearney<sup>20</sup> experienced difficulty in maintaining patency in a 14 year old child. This girl had unilateral bony atresia, and after the obstruction was removed the posterior edge of the septum was bitten away. The surgeon then inserted a piece of gauze after the method of Brady<sup>21</sup> into the side operated on. The gauze was caught in the nasopharynx and drawn through the opposite side, and the ends were tied around the columella. The knot was untied daily, and a fresh strip of gauze was attached to one of the free ends. The fresh gauze was then pulled through the nose and tied as before. The procedure proved very painful and had to be abandoned. Three weeks afterward the choanal opening had closed, necessitating a secondary operation, which included a submucous resection of the nasal septum. Even in the adult cicatricial stenosis occurs, as was evident in the woman operated on by Lebensohn. In this case the posterior naris had closed six months after the operation and if the opportunity presented itself Lebensohn planned to do a resection of the nasal septum to secure a permanent passage.

It is evident from the foregoing experiences with this method of removing the posterior edge of the septum with the obstructing plate that overcorrection is needed at the time of the primary operation and that more of the septum should be removed to insure postoperative patency. While no harm may follow in the adult, it is questionable whether or not a more elaborate extirpation of tissue would be advisable in the infant or the young child.

The method of simply removing the obstructing plate and inserting a skin graft on an obturator, as presented here, offers a new approach

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19 Colver, B. N. Congenital Choanal Atresia. Two Cases of Complete Bilateral Obstruction, *Ann Otol, Rhin & Laryng* **46** 358 (June) 1937.

20 Kearney, H. L. Congenital Bony Atresia of Right Posterior Naris, *Ann Otol, Rhin & Laryng* **45** 583 (June) 1936.

21 Brady, A. J. Atresia of the Choanae, *J. Laryng, Rhin & Otol* **33** 49 (Feb.) 1918.

to a tedious problem. For children it has the particular advantage of precluding the necessity of postoperative instrumentation. For the adult the principle may be successfully modified, as was demonstrated by Dr. Albert D. Davis,<sup>22</sup> of San Francisco, who suggested the method described in this report. His patient, a woman of 25, had unilateral bony atresia, which he removed with rat-tail file and chisel. He then inserted a skin graft on a large catheter. After healing, a catheter attached to silver splints was kept in the nose for two and one-half months. Blair<sup>4</sup> was the first to suggest the use of a skin graft to maintain postoperative patency. He employed this method in a case in which he chiseled through a solid piece of bone to make an artificial nasal cavity.

#### REPORT OF A CASE

A girl aged 4 years, alert and inquisitive, referred by Dr. H. J. Lenahan on Aug. 18, 1936, had had a discharge from the right side of the nose since birth. As a rule it was colorless, but on several occasions, especially during the winter, it had a distinctly greenish tint. She experienced difficulty in blowing the nose, and during sleep her breathing was of a snorting character. Nursing at the breast was often interrupted by a peculiar type of breathing, which would disappear after she had taken a few large gasps of air through the mouth. The family physician attributed this irregular breathing to an enlarged thymus, but roentgen therapy proved of no avail.

At 5 months she had pneumonia, and during the following eighteen months contracted pertussis, measles and chickenpox. There was no evidence of a congenital anomaly in the father, the mother and the two older brothers.

Examination revealed a thick, slightly greenish discharge on the floor of the right fossa. The mucous membrane was a little paler than normal, and the part covering the anterior tip of the inferior turbinate bone was hypertrophied to the extent of showing mulberry-like dimpling of the mucosa. There was no perceptible atrophy of the concha. The left fossa had a normal mucosal lining and was free from any secretion. The child was seen on only two occasions, and her apprehension made the use of a nasopharyngoscope inadvisable. Both tympanic membranes were normal, and there was no impairment of hearing. The faucial tonsils showed moderate hypertrophy, and the palatal arches were symmetric. The voice had a distinctly nasal twang.

It was thought after the initial examination that either syphilis or suppurative sinusitis was present. On the second examination the mother presented a report from the family physician to the effect that he was unable to secure a specimen of the child's blood but that the mother's Wassermann reaction was negative. Roentgen study of the sinuses pointed toward infection of the ethmoid cells and the right maxillary sinus, with chronic thickening of the mucosa along the nasal wall of the antrum.

In view of the thick greenish nasal exudate and the roentgen finding of sinus abnormality it was decided to improve nasal ventilation by removing the hypertrophied tonsils and adenoids. After operation a nasal Sennexon dilator was passed through the nostrils only to meet with firm resistance on the right side posteriorly.

22 Davis, A. D. Personal communication to the author.

After shrinking the nasal mucosa I made an examination of the obstructing area. No mass was discernible on the posterolateral wall, and the choanal occlusion appeared to be immediately continuous with the posterior tip of the middle turbinate bone. The nasopharyngoscope could not be passed into the nasopharynx. On digital examination of the nasopharynx I was unable to find any opening into the right choana. The obstructing wall was composed of a smooth hard plate of bone immediately within the free posterior border of the septum. After separating the blades of the nasal dilator, I passed one blade through the right nostril and with considerable pressure, comparable to that used in making an antral puncture, perforated the obstruction. A diagnosis of congenital atresia was made, but no surgical procedure was attempted, as the blood for the Wassermann test was not obtained until just before the operation.

The patient returned home, and for one month a local rhinologist kept her under observation. The opening in the choana soon closed, and on October 12, the patient was admitted to the Hospital of the University of Pennsylvania, where medical studies were supervised by Dr J Clayton Gittings and the immediate rhinologic problem delegated to me under the service of Dr George M Coates.

At this time particular note was made of the nasal characteristics of the patient's voice, which was classified as having typical rhinolalia clausa, and my associates and I were able to demonstrate this quality on a phonograph record. The child was unusually alert and her intelligence quotient well beyond the normal. The general physical examination gave essentially negative results. Roentgen study of the chest showed nothing abnormal, and an electrocardiographic examination revealed simple tachycardia. The Kolmer and the Kahn test were negative, and the blood count was normal.

The routine roentgenogram of the posterior nares (fig 3) is an unusual study showing confirmatory evidence of osseous occlusion of the right posterior naris. Dr Eugene P Pendergrass, roentgenologist, reported as follows: The posterior naris on the left side is patulous, as is shown at *A*. The posterior naris on the right side is definitely different from that on the left, and there is a suggestion of bony abnormality. This side was known to be clinically obstructed, and it is suggested that such variance in the appearance of a posterior naris may in the future be regarded as roentgenographic evidence of bony occlusion. Normally the posterior nares in this projection look symmetric, and there is no large amount of space between. In this instance, however, there is a considerable space, seen at *C*.

That the occlusion was complete is evident from a similar coronomental view of the right posterior naris after injection of iodized poppyseed oil, as shown in figure 4. Despite the complete obstruction of the right choana, the sinuses on that side appear normal in a posteroanterior projection, as shown in figure 5, and their development is equal to those on the left, or unobstructed, side. The frontal sinuses show early development. This figure, in which the absence of sinusal abnormality is apparent, is not to be confused with the primary roentgen study, not shown here, which pointed toward ethmoidal and antral pathologic changes on the right side.

In order to make the interpretation of the shadows cast by the normal posterior nares, or choanae, more evident we utilized for demonstration the cadaver from which the drawing in figure 2 was made. Figure 6 shows a piece of lead occupying the entire left choana. The floor, or the junction of the hard and the soft palate, is shown at *A*. The roof appears projected posteriorly and is shown at *B*.



Fig 3—Coronamental view demonstrating the roentgen changes in the right posterior naris. *A* indicates the patent naris on the left side and *B* the occluded naris on the right side. Note the absence of normal symmetry of the nares and the unusually large space at *C*.



Fig 4—Coronamental view taken after the injection of iodized poppyseed oil, demonstrating the obstruction in the right posterior naris.



Fig 5—Posteroanterior view demonstrating the apparently healthy paranasal sinuses



Fig 6—Coronometal view of a cadaver, showing the shadows cast by the normal posterior nares A piece of lead outlines the walls of the left choana The nares are symmetric

*Operation*—On November 3, after the patient was anesthetized with divinyl ether, the nasal mucosa was well shrunk with a solution of 4 per cent cocaine hydrochloride and 1 1,000 epinephrine. The choanal obstruction was first perforated with a nasal Sinnexon dilator, and then a few pieces of the bony wall were removed with a small biting forceps and saved for histologic study. The larger end of a Faulkner curet proved ideal for breaking down the remaining thin bony partition. To guard against instrumental injury of the adjacent parts, the rotary movements of the curet were guided by the index finger placed in the nasopharynx. The diameter of the curet, 1 cm., was a tangible guide in determining the proper size to make the choana before inserting the obturator and skin graft. Dr. Julius Johnson removed a full thickness skin graft 2.5 cm. square from the child's abdomen, and this was trimmed down to fit snugly around a no. 18 French woven catheter, which previously had been measured to equal the length of the nasal fossa from the anterior to the posterior naris. The skin graft circling the posterior end of the rubber tubing measured from 1.5 to 2 cm. in width and was attached to the catheter to prevent slipping by two no. 00 catgut sutures. The rubber obturator was then inserted along the floor of the nose until it reached the guiding finger in the nasopharynx. The raw surface of the graft was then in contact with the freshly denuded area of the choana. A silk suture was placed in the anterior end of the catheter, which remained immediately within the nostril, and the projecting end of the tie was anchored to the cheek by adhesive tape.

The tissue of the occluding wall removed at operation, a section of which is shown in figure 7, was studied at the Pepper laboratory by Dr. Herbert A. Fox, who reported as follows: There are pieces of poorly constructed bone and cartilage. The bone is probably normal, but in two places it is combined with loose fibrillar tissue, the identity of which is not clear. No distinct marrow elements can be seen. There is no suggestion of a syphilitic inflammation or of tumor.

The postoperative care consisted of frequent nasal instillations of 1 5,000 metaphen solution. The French woven catheter was removed on the tenth day, and my misgivings were allayed when the skin graft was found to be adherent to the choana. A slight odor and discharge on the affected side increased during the following week. The discharge became very rancid and presumably arose from the retained secretion in the sweat and sebaceous glands of the skin graft. During the third week the exudate decreased, and the child was discharged from the hospital on November 29.

After eleven months there was no evidence of nasal secretion and the patient was able to breathe comfortably through the right side of the nose. The snorting at night had disappeared, and, with general improvement in her appearance, she had gained 6 pounds (2.7 Kg.). The choanal opening was estimated at 6 or 7 mm. in diameter, or large enough for a Holmes nasopharyngoscope to be passed. The patency is demonstrated in figure 8 with a eustachian catheter. While the voice had not returned to normal, noticeable improvement had been recognized by her family and friends. We were able to demonstrate this change on the opposite side of the phonographic record which eleven months ago had recorded her rhinolalia clausa type of speech.



Fig 7—A section from the excised diaphragm, showing calcified matter and fibrous tissue on each side The mucosa had been mechanically disturbed



Fig 8—Lateral view of the nasopharynx made nine months after operation, demonstrating the patency of the right posterior naris

## CONCLUSIONS

This case suggests the advisability of exploring the nasopharynx and the choanae with a finger or instrument during all operations on the nose or throat in children

When there is chronic unilateral nasal discharge the possibility of choanal obstruction should be kept in mind

As an aid to diagnosis roentgenography may be used to advantage

The perplexing problem of postoperative cicatricial stenosis was overcome in this case by the use of a whole skin graft

The patency of the posterior nares one year after operation was interestingly demonstrated by the improved resonance of the voice as recorded on a phonographic disk

2008 Walnut Street



# Abstracts from Current Literature

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## Ear

VERTIGO IN BRAIN TUMORS, WITH SPECIAL REFERENCE TO THE RESULTS OF LABYRINTH EXAMINATION E A SPIEGEL and A ALEXANDER, *Ann Otol, Rhin & Laryng* **45** 979 (Dec) 1936

The observations of Spiegel and Alexander on tumor of the brain seem to corroborate the assumption of a representation of the labyrinth in the cerebral cortex, particularly in the temporal lobe. Parts of the frontal lobe, especially the centro-opercular region, must be taken into consideration as places at which vestibular and spinal impulses joined in the subcortical (cerebellorubral system) may enter. The concept that vertigo in association with tumor of the brain is only a general symptom of increased intracranial pressure seems to need revision. In a large number of cases symptoms of choked labyrinth hyperexcitability of this organ, differences in excitability between the two sides, nystagmus, diplopia and cerebellar disturbances are found, and the appearance of vertigo is explainable as due to these effects of increased intracranial pressure. Yet there remains a group of cases in which such an effect of pressure on the labyrinth or on the brain stem is absent. In these cases, at least, it seems not unreasonable to assume that the vertigo may appear as a local symptom of the cerebral cortex due to direct lesion (stimulation) of the aforementioned cerebral areas or to pressure on these foci by a tumor in a neighboring region. In general, it seems that a tumor close to the sylvian fissure induces vertigo more easily than does a tumor more distant from this fissure.

EDITOR'S ABSTRACT [J A M A]

STREPTOCOCCIC DERMATOSES OF THE EARS JAMES H MITCHELL, J A M A. **108** 361 (Jan 30) 1937

According to Mitchell, many of the eczematous eruptions in and around the ears are due to the invasion of streptococci. He agrees with the opinion of Sabouraud, who named such manifestations *Streptococcides eczematiformes*. Besides causing a retroauricular intertrigo, the streptococci may cause the formation of scaly, exudative patches in the cavum and in the canal. Itching is a common complaint. The diagnosis must be verified by laboratory tests. Streptococci may be readily demonstrated in serum from fissures and in the squama-like crusts. Cultures are more difficult to make, and Mitchell advocates the use of brain broth-dextrose medium in tubes at least 12 inches (30.4 cm) long. In the cases described by Mitchell no fungi were observed, and the possibility of external irritants was excluded.

LEWIS, New York [ARCH DERMAT & SYPH]

SURGICAL TREATMENT OF MENINGITIS OF OTITIC AND NASAL ORIGIN G E SHAMBAUGH JR, J A M A **108** 696 (Feb 27) 1937

During the last four years Shambaugh Jr observed 8 cases of meningitis of otitic or nasal sinus origin in his practice and in the house service of the Presbyterian Hospital. Two patients died of sepsis (1 of thrombosis of the lateral sinus and the other of thrombosis of the superior sagittal sinus), and 1 patient, of duodenal hemorrhage. The meningitis in these 3 cases was localized and was not the immediate or the contributory cause of death. The remaining 5 patients with meningitis were treated successfully according to the accepted principle of making the earliest possible diagnosis by examination of the spinal fluid at the first suspicion of meningeal invasion. The cell count is the important consideration. A sharp differentiation must be made between localized meningitis, with an increased number of cells but no organisms on smear or culture and a

normal sugar content, and generalized meningitis, with organisms on smear and culture and diminution or absence of sugar. As long as the meningitis is localized, treatment should be confined to thorough surgical drainage of the focus in the ear or the sinus. Occasionally a few organisms may be observed on smear but not on culture, and here simple drainage of the suppurative focus may suffice to produce a cure. The prognosis in localized meningitis is good if the disease is recognized promptly and dealt with. Once generalized meningitis has developed, incision and drainage of the dura at or near the point of entry of the infection may be considered, forced drainage of spinal fluid by the method of Kubie may be employed, the intracarotid administration of antiseptics may be tried, or simply repeated lumbar punctures may be relied on. While the prognosis for generalized meningitis of otitic or nasal sinus origin is usually poor, occasionally recovery does occur, especially when the meningitis is due to the streptococcus.

EDITOR'S ABSTRACT [ARCH NEUROL & PSYCHIAT]

A STUDY OF MASTOID INFECTION IN CHILDREN M HINES ROBERTS, South M J  
29 1207 (Dec) 1936

Many mastoid infections do not require surgical treatment. Persons with such infections frequently present clinical and roentgenographic evidence practically identical with that for patients who finally come to operation.

Even when destruction and necrosis are shown by roentgen examination to be taking place in the mastoid, recovery may occur without operation.

Conservative treatment of all patients is recommended, and the author disproves the old idea that early operation for acute involvement of the mastoid is essential to avoidance of grave complications.

The time element is most important in evaluating all clinical laboratory data. The postponement of operation for one, two or even several days will not endanger the patient and will in most instances obviate the need for surgical intervention.

It is most important to have close cooperation between otologist, roentgenologist and pediatrician, and there should be careful daily comparison of evidence by these three specialists.

SCHLUTZ, Chicago [AM J DIS CHILD]

THE PREVENTION OF ACUTE SURGICAL MASTOIDITIS WELCH ENGLAND, West  
Virginia M J 32 560 (Dec) 1936

A certain percentage of infections of the middle ear will heal spontaneously. A certain percentage will go on to mastoiditis, regardless of any or all conservative methods of treatment. Between these two extremes lie the great majority of conditions that confront the otologist.

The author discusses the various causes of mastoiditis and concludes that in about 98 per cent of cases the condition follows an acute infection of the nose and throat, ascending by way of the eustachian tubes.

In most cases the patient is in the age group from 8 to 16 years. With temperature ranging from 99 to 105 F, profuse perspiration, draining of the ears and visible clouding of the mastoids under roentgen examination, there is undoubtedly acute mastoiditis, but just as certainly the patient is septic and should not be operated on. A leukocyte count of about 15,000, associated with a shift to the left of the Schilling differential count still indicates a complicated septic form of infection of the upper part of the respiratory tract. A patient should not be operated on at the time of such manifestations, but operative procedure should be delayed until there is a shift back to a more even range of temperature and a more normal Schilling-Kolmer differential count.

Caution and delay are the watchwords in this article.

SHAWKEY, Charleston, W Va [AM J DIS CHILD]

VENTRICULAR COMMUNICATION AND INTERNAL HYDROCEPHALUS AS COMPLICATIONS OF BRAIN ABSCESS FRANCIS MCGUCKIN, *Lancet* **2** 1387 (Dec 12) 1936

Three cases of otogenic abscess of the temporal lobe in which recovery followed establishment of ventricular communication form the basis of this report. These cases demonstrate that tension may be severe and that its relief under certain circumstances may make for rapid recovery. In 1 case the abscess was sufficiently large to cause extensive compression of the homolateral ventricle, and the large amount of cerebrospinal fluid evacuated would point to the rupturing segment as probably the anterior horn and the adjacent part of the body.

If intervention is not delayed unduly, evacuation of the content of the abscess will usually relieve the pressure responsible for the block in cerebrospinal circulation and will accomplish this much more safely than will direct interference with the system.

LANGMANN, New York [AM J Dis CHILD]

MASTOIDITIS IN INFANTS H. GRENET, R. LEVENT and D. ISAAC-GEORGES, *Bull Soc de pediat de Paris* **34** 111 (Feb) 1936

Autopsy of 86 infants under 2 years old of whom aural examination had shown no abnormality during life showed involvement of one or both mastoids in 54. One hundred and fifty-five infants who had otitis media were divided into three groups: (1) those who had a discharge from the ears, (2) those who showed signs of inflammation of the ears and (3) those in whom examination of the ears revealed no abnormality even after paracentesis but in whom there was evidence of mastoid infection at autopsy. The conclusions are that all sick infants should have regular examinations of the ears, paracentesis should be done when necessary and antrotomy if it becomes necessary. The authors express the belief that when aural examination shows no abnormality mastoiditis observed at necropsy is a result rather than a cause of the infant's condition and that operation is usually ineffective in such cases.

BENJAMIN, Montreal, Canada [AM J Dis CHILD]

LATENT OTOMASTOIDITIS AND ACUTE DEHYDRATION IN INFANTS J. CATHALA, LORAIN and MOREL, *Bull Soc de pediat de Paris* **34** 505 (Oct) 1936

When infants with digestive disturbances and toxemia present no demonstrable cause for the illness and continue without improvement despite treatment, they may have latent mastoiditis, and antrotomy may be necessary or even life saving. An instance illustrating this statement is cited, as well as one in which bilateral antrotomy revealed no abnormality of the mastoids and necropsy showed an inflammatory condition of the pyloric canal probably associated with a duodenal ulcer. Of course, not all infants with severe diarrhea and dehydration have latent mastoid infections. Clinical diagnostic ability, which even at its greatest is not infallible, is necessary in deciding whether mastoid antrotomy is indicated.

BENJAMIN, Montreal, Canada [AM J Dis CHILD]

NOISES IN THE EAR, TINNITUS AND ELEMENTARY, COMMON AND VERBAL AUDITORY HALLUCINATIONS FERDINAND MOREL, *Encephale* **31** 81 (July) 1936

In classifying the heterogeneous phenomena of auditory disturbances, Morel uses the cochlear path as a guide. Peripheral noises of extraneural origin—muscular and vascular bruits—are characterized by monotony and relatively low complexity. The noises which originate in the cochlea, the primary neuron or the projection fibers from the medullary nuclei to the cortex have the same characters. They are elementary noises and have no significance and no verbal form. The patient compares his sensation to some noise such as the roar of the sea, and if he has no appropriate term of comparison he imitates it by onomatopoeia. The noises are localized subjectively near the ear, in the ear or in the head, but not in the sonorous space. Only the associated signs and symptoms can indicate the level of the lesion. An altogether different group of auditory phenomena consists

or noises which are localized externally, in the subject's sonorous space. They are defined not, as in the preceding group, by onomatopœia but by direct reference to their supposed external source. The localization follows the laws of acoustics. These noises "irrupt" into consciousness in company with nonauditory, particularly tactile and visual, elements, bringing about cohesion of the entire process and absolute, or almost absolute, belief in their reality. No gross cerebral lesion produces these phenomena. The functions involved are those which disappear in auditory agnosia. Just as auditory agnosia is generally associated with word deafness to some degree, these common auditory hallucinations are usually related to verbal hallucinations.

Verbal auditory hallucinations involve the phasic function. They depend on the patient's verbal ideation and are closely related to his character, prepsychotic habits and intentions. The voice is heard at any site, either in the patient's body or at any distance within or without the range of the normal voice. Its vocal characters are difficult to describe. The patient never imitates the voice. A general law, to which Morel has never seen an exception, is that two voices with different contents, or simply two systems of different phenomena, are mutually exclusive. They never occur at the same time, though they may alternate. It is best to observe these phenomena at the moment when they occur. In addition to inducing introspection the observer should use objective methods. They include observation of the patient's motor responses, particularly by the use of special recording technic such as cinematography of the pupil and sensory examination. Claude, Aubry and Baruk noted the inconstancy of labyrinthine reactions in cases of paranoid dementia. Morel observed patients with chronic hallucinatory psychosis with the electric audiometer. A sudden, brief hypoeccitability almost always corresponded to an auditory verbal hallucination. Sudden disturbances in respiratory rhythm were noted by Paterson. Morel suggests the use of stroboscopic laryngoscopy and electromyography of the muscles of respiration, articulation or phonation. The importance of motor phenomena is shown by the attempts made by some patients to eliminate auditory hallucinations by inhibiting lingual and respiratory movements. One patient, accustomed to using a digital sign language, accomplished this inhibition by flexing her fingers strongly and asked that her fingers be cut off. The movements of phonation, however, are not sufficient to create verbal hallucination, a special state, summarized as automatism, must be present.

Tinnitus ordinarily has no relation to hallucination, yet in 2 patients with traumatic rupture of the tympanic membrane tinnitus was transformed into common auditory hallucination, attributed to an external cause, when ether was administered or the patient was falling asleep.

LIBER, New York [ARCH NEUROL & PSYCHIAT]

EAGLETON'S SYNDROME F. J. COLLET and R. MAYOUX, Rev. d'oto-neuro-opht  
14 727 (Dec.) 1936

The case reported was that of a woman aged 56 who suffered a stroke in 1926, which was followed by paralysis of the left facial nerve. Later, violent headaches and vomiting appeared, and all the cranial nerves on the left side except the optic became involved. Examination revealed complete deafness in the left ear and no reactions to caloric tests. In the right ear hearing was normal, and the caloric test revealed marked reaction in nystagmus and vertigo from the horizontal canal but no reaction from the vertical canals.

In France it is not generally admitted that elective functional disturbance of the vertical canals exists. Hautant considered such disturbance a sign of vestibular hypoeccitability, as did Weill. Aubry and Caussé regarded it as pseudoparalysis of the vertical canals. Collet and Mayoux cannot admit that there was hypoeccitability of the right labyrinth in their case. They think the phenomenon was an elective functional disturbance of the vertical canals.

DENNIS, San Diego, Calif [ARCH NEUROL & PSYCHIAT]

IMPORTANCE OF INFLAMMATION OF THE MIDDLE EAR AND MASTOIDITIS IN INFANCY  
FROM THE PEDIATRIC STANDPOINT J CSAPO, Arch f Kinderh 109 203, 1936

Inflammation of the middle ear and the connected parts can produce a variety of clinical symptoms in infancy. The following forms are distinguished: the meningeal form, otogenic sepsis and septic, toxic and septicotoxic inflammation of the middle ear, antral empyema, and mastoiditis. Infection of the middle ear is one of the most important complications of dysentery in infancy and early childhood. Correctly timed paracentesis or trepanation will aid greatly in relieving the intestinal symptoms. CRANE, Washington, D C [AM J DIS CHILD]

### Pharynx

THE RADIOLOGICAL TREATMENT OF CANCER 1929-1935 V CARCINOMA OF THE  
TONGUE G E RICHARDS, Canad M A J 35 593 (Dec) 1936

Richards reports the results of treatment in 101 cases of cancer of the tongue. In 73 per cent, the lesions were advanced. Healing of the primary lesion by radiologic treatment was obtained in 54 per cent. Control of the disease was obtained in 34 per cent. Richards points out that conservation of tissue is an important consideration in the treatment of lesions of the tongue and that radiologic methods are advantageous in this respect. He feels that there is an urgent need for early diagnosis and treatment.

LEWIS, New York [ARCH DERMAT & SYPH]

THE RADIOLOGICAL TREATMENT OF CANCER 1929-1935 VI INTRA-ORAL LESIONS  
(EXCEPT THE TONGUE) G E RICHARDS, Canad M A J 35 599 (Dec) 1936

Of 158 cases of carcinoma of the mouth studied by Richards, the point of origin was the alveolus in 60, the floor of the mouth in 30, the buccal mucosa in 55 and the roof of the mouth in 13. While treatment was individualized, radiologic methods were employed principally in the treatment of the primary lesions. When metastases to regional lymph nodes occurred, surgical methods were resorted to, together with roentgen or radium treatment. In 72 per cent of the cases the disease was in the advanced stage when the patient was first seen. Investigation of the results of treatment showed that 69, or 43 per cent, of the patients were alive and free from symptoms, 5 were alive but not free from the disease, 70, or 44.3 per cent, died of the disease, 10 died of extraneous diseases, and 4 were untraced. Richards stresses the advantage of early diagnosis, since of 29 patients treated during the early stage of the disease, 27, or 93.1 per cent, were cured.

LEWIS, New York [ARCH DERMAT & SYPH]

EXPERIENCES WITH ROENTGEN THERAPY OF MALIGNANT EPIPHARYNGEAL TUMORS  
AT ROENTGEN INSTITUTE IN ZURICH H R SCHINZ and A ZUPPINGER,  
Ztschr f Hals-, Nasen- u Ohrenh 41 173, 1936

After reviewing their experiences with roentgen therapy during an earlier period, Schinz and Zuppinger report their observations in 26 cases in which they treated epipharyngeal tumor between 1929 and 1935. In discussing the clinical aspects of these cases, the authors state that in all of them the tumor was in an advanced stage of development, the majority of the patients already having metastases. Histologic studies revealed that 16 patients had carcinoma and 9 sarcoma. In 1 case histologic examination was dispensed with. The majority of the carcinomas were of the lymphoepithelial type, which the authors regard as the chief form of carcinoma of the epipharynx. The sarcoma belonged to various histologic types.

Treatment usually consisted of protracted-fractional distant roentgen irradiation. There was no palliative effect from this treatment in 6 cases, but in the other 20 cases all or some of the symptoms disappeared.

EDITOR'S ABSTRACT

## Nose

### OPHTHALMOLOGIC SEQUELAE IN THE RADICAL CURE OF FRONTOETHMOID SINUSITIS

P HALBRON, Bull Soc d'opht de Paris, October 1936, p 636

The ocular complications following operation on the frontal sinus are well known. Halbron reviews such complications in 48 cases. These are grouped as cases of (1) difficulty with motility of the globe, (2) lacrimal complications, (3) palpebral complications and (4) corneoconjunctival complications.

In 4 of Halbron's patients the complications fell in the first group. Diplopia was the leading symptom. He cautions that treatment must be delayed, as restitution may occur even as late as three months after the operation. Graphs of the muscular balance in these 4 patients are shown. Interference with lacrimation is most likely due to subcutaneous inflammation. Complications affecting the lid are frequent. Even after healing, inflammation may persist at the internal angle of the lid. Infection of the conjunctiva has been reported, but this did not occur in Halbron's cases. Keratitis without ulceration, however, was frequent.

Halbron concludes that complications may be minimized if the rhinologist keeps in mind the following points:

- 1 The proper incision avoids the lacrimal sac by passing under and to the side of it.

- 2 The periosteum of the orbit is removed except in the region of the pulley of the superior oblique muscle.

- 3 The lids must be held closed after the operation.

A bibliography is appended.

L. L. MAYER, Chicago [ARCH OPHTH]

### RESULTS OF TWENTY YEARS OF OBSERVATION AND THERAPY OF OZENA

K AMERSBACH, Arch f Ohren-, Nasen- u Kehlkopfh **142** 106, 1936

Amersbach surveys his own experiences and reviews the literature for the last twenty years with regard to ozena. He reviews various theories of the cause and then evaluates the different surgical methods which he himself has tried. He is convinced that no one any longer speaks of a morphologic-anatomic cure for ozena but shows that there are still some who consider clinical cure—that is, elimination of the bad odor, of the crust formation and even of the atrophy—possible. He himself takes a more critical attitude, pointing out that, although there are many different therapeutic methods, none can be said to effect complete cure, each of them at the most effecting only an improvement of the symptoms. In conclusion he stresses general treatment and the improvement of the hygienic conditions as factors in handling the disease.

EDITOR'S ABSTRACT

### RADICAL OPERATION ON FRONTAL SINUS

G HOER and T MOTLOCH, Monatschr f Ohrenh **70** 1339 (Nov) 1936

Hofer and Motloch stress as important for the success of the radical operation on the frontal sinus (1) that the diseased mucous membrane must be radically removed and (2) that the connection between the nose and the frontal sinus must be preserved at all costs. In order to insure such a connection, it is important to preserve the supporting frame of the nasofrontal duct and to make a communication between the two cavities by removing the ethmoid and the sphenoid, even in those cases in which they are not involved in the disease process. The authors emphasize that if the radical operation is performed in this manner there is little danger of a relapse, and they prove this in a number of cases.

EDITOR'S ABSTRACT

THERAPY OF ACUTE RHINITIS BY INTERNAL MEDICATION F HUTTER, Monatschr f Ohrenh **70** 1355 (Nov) 1936

Hutter reviews studies on the common cold reported by H S Diehl (Medicinal Treatment of Common Cold, *J A M A* **101** 2042 [Dec 23] 1933) and points out that Diehl, in studying the efficacy of the various medicaments on a large number of patients with acute coryza, found that a combination of codeine and papaverine is to be recommended for general use. Hutter further states that his own investigations on this problem largely corroborate Diehl's observations on the favorable effects of codeine and papaverine.

EDITOR'S ABSTRACT

### Miscellaneous

HOUSE DUST HYPERSENSITIVITY IN PERENNIAL ASTHMA OF CHILDHOOD HENRY N PRATT, *J Allergy* **8** 60 (Nov) 1936

The author's summary is as follows:

"By means of intracutaneous tests and passive transfers it has been determined that approximately 79 per cent of children between the ages of one and twelve years who suffer from perennial asthma are skin sensitive to house dust extract and have reactions to this atopen in their scrums. The frequency and severity of this sensitivity as evidenced by the magnitude of the skin test and passive transfer reaction increase with the advancing years of childhood."

HOVER, Cincinnati [AM J DIS CHILD]

INFECTIONS OF THE UPPER RESPIRATORY TRACT IN CHILDREN H M JAY, M J Australia **2** 774 (Dec 5) 1936

Jay observes that infections of the upper part of the respiratory tract in children are more potentially serious than those in adults, some children are hypersusceptible to them and have difficulty in throwing them off, defective nasal breathing and malocclusion of the jaws are predisposing factors, allergic states must not be confused with ordinary "colds", pneumonia is frequently secondary to infection of the sinuses, an infection of a sinus frequently causes persistent "cold", the first sign of sinusitis may be orbital swelling, a unilateral nasal discharge should always arouse suspicion of the presence of a foreign body in the nose, the free use of meat and fruit juices in the diet as a supplement to milk and carbohydrates raises the immunity to infection, calcium therapy is a useful adjunct in treatment, menthol is not acceptable to the nasal mucous membrane, nasal douches are liable to carry infection to the middle ear, and autogenous vaccines have a great influence in cleaning up these infections.

GONCE, Madison, Wis [AM J DIS CHILD]

TASTE AND SMELL IN THE NEWBORN F STIRNIMANN, Rev franç de pédiat **12** 453, 1936

On the basis of the vasomotor and the motor reflexes, Stirnimann finds that the newborn infant is capable not only of perceiving gustatory stimuli but of distinguishing them. The infant is capable of responding to olfactory stimuli but not as consistently as to gustatory ones. Nasal taste is more developed than smell itself. The latter serves to complete taste. Examinations have shown not only simple reflex responses but more complicated reactions which one must range among psychic manifestations.

LESLIE, Evanston, Ill [AM J DIS CHILD]

CLINICAL FORMS OF OSTEOMYELITIS OF THE ROOF OF THE ORBIT G WEILL and A KOUTSEFF, Rev d'oto-neuro-ophth **14** 629 (Nov) 1936

Two cases are reported, both of osteomyelitis of the lesser wing of the sphenoid bone and both of fatal outcome due to meningitis. Osteomyelitis of the lesser wing

of the sphenoid bone is so rare that in 1921 Cange discovered only 1 indisputable case in the literature. Clinically the condition is characterized by acute palpebral edema (not under marked tension), unilateral exophthalmos, integrity of the neighboring accessory sinuses, a normal reaction to puncture of the orbit and early acute aseptic meningitis with its complications (papillary stasis, paralysis of the oculomotor nerve and cerebral abscess). Taken together, these symptoms aid in differentiating the condition from acute inflammatory disease of the orbit, sinusitis or suppurative phlebitis of the cavernous sinus.

DENNIS, San Diego, Calif [ARCH NEUROL & PSYCHIAT]

MOVEMENTS OF LABIA VOCALIA DURING PHONATION H WULLSTEIN, Arch f Ohren-, Nasen- u Kehlkopf 142 119, 1936

Wullstein studied the movements of the labia vocalia on the excised larynges of calves and of human subjects with a photoelectric cell that recorded not only the light falling through the rima glottidis but that shining through the labia vocalia. He was able to demonstrate that the movements of the labia vocalia are upward as well as sideways and that during the movement there is a considerable shifting in the mass of the labia. He found that at first there is an upward movement of the closed labia, which for the duration of the phonation do not return to their true position of rest (closed and not inflated) but merely assume a zero position. Although closed, they remain vaulted. Whereas the roentgenographic curve of the opening of the rima glottidis indicates a brief opening phase with a sharp-angled outline, that recorded by the photoelectric cell proves that the movement within the labia vocalia takes place by a shifting of the masses, with a gradual transition of the back swing into the forward swing. In this movement the first point of contact between the labia during the back swing seems to be within the fasciculus of elastic fibers on the under surface, which in the course of the vaulting and shifting of masses moves farthest toward the medial line. The type of the curve of movement is the same for the larynx of a calf and of a human being (that is, in the larynx without and that with Morgagni's ventricle), but the ratios of the duration of the opening and the closing phase differ. In calves the ratio is 1 to 4 and in human beings 1 to 1. Moreover, in the human larynx loud and vigorous sounds can be produced by comparatively small pressures and quantities of air and the organ is more sensitive to augmentations in pressure. In its natural mode of action it is more sparing with the use of air and pressure and thus is better suited for prolonged use than is that of the calf. Even when the labia vocalia are not closed before air is blown against them they are often capable of producing sounds. At the onset of phonation in such circumstances there is first an approximation of the labia (caused by suction or by pressure from above). During phonation the larynx often completely closes. It may be assumed that a similar action is exerted on well closed labia vocalia.

EDITOR'S ABSTRACT

DIRECT SIGNS OF TUMOR OF THE BRAIN IN ORDINARY ROENTGENOGRAMS OF THE SKULL H HELLNER, Beitr z klin Chir 164 583 (Dec 23) 1936

Diagnosis of tumor of the brain must answer three questions: the location, the size and the nature of the tumor. According to Hellner, the usual roentgenogram of the skull is capable of contributing important information on these subjects. Knowledge of the alterations caused by a tumor and visualized in an ordinary roentgenogram of the skull, while not as important as the results of neurologic examination and the knowledge of the course of an individual tumor, is nevertheless of considerable value. The author cites Kornblum, who observed calcification in 65 per cent of 446 cases of tumor of the brain in which the diagnosis was confirmed by operation or at necropsy. The types of intracranial tumor exhibiting bone formation were, in the author's experience, principally parasagittal meningioma, neurinoma and cholesteatoma. Here the roentgenogram furnishes informa-



tion as to the localization, the size and, to some extent, the nature of the tumor. The author describes localized hyperostoses of the vault and the base of the skull. These were likewise observed principally in cases of meningioma, and occasionally of benign glioma and acoustic neurinoma. The roentgenogram furnishes information as to both the localization and the nature of meningioma. Histologic studies of meningioma characterized by a tendency to hyperostosis demonstrated invasion of bone by tumor cells. The roentgenologic and clinical differentiation of osteoma and meningioma no longer offers serious difficulty. One must be careful in interpreting erosion and atrophy of the skull, which can be caused by general increased pressure in the brain, as well as by the direct pressure of a tumor. They do not furnish any definite evidence of a topographic, qualitative or quantitative kind. The value of roentgenologic signs in the diagnosis of the nature of a tumor of the cerebellopontile angle is limited. On the other hand, the topographic diagnosis of tumor of the acoustic nerve is, as a rule, reliable. The size of the tumor cannot be told from a roentgenogram.

EDITOR'S ABSTRACT [J A M A]

CORNEAL LESIONS AFTER REMOVAL OF THE GASSERIAN GANGLION FOR TRIGEMINAL NEURALGIA C. DRUTTER, *Deutsche Ztschr f Chir* 248 55 (Dec 9) 1936

Drutter reports that among 69 patients treated for trigeminal neuritis by the injection of alcohol into the gasserian ganglion, keratitis developed in 17 (24.6 per cent). In 9 (52.9 per cent) the lesion became permanent. Eighteen patients were subjected to twenty-seven operations for removal of the gasserian ganglion. The cornea remained normal in all cases. Drutter concludes that neoparalytic keratitis develops only as a result of anesthesia of the cornea. The cause of keratitis remains unexplained in spite of many studies. Primary trigeminal neuralgia seldom involves the first branch of the nerve. Pain in the area of this branch is considered secondary by many authors. The incidence of corneal anesthesia and consequent disease of the cornea cannot be diminished through the practice of injecting alcohol into the gasserian ganglion developed in Germany. Subtotal section of the posterior ganglion section of the root of the trigeminal nerve, according to the method of Frazier and Spiller, does not lead to loss of sensitiveness of the cornea and to neuroparalytic keratitis. The persistence in Germany of a high mortality following operative intervention is due to lack of experience. Injection of alcohol makes the operative intervention even more difficult. Subtotal section is followed by a smaller percentage of recurrences than is injection of alcohol. According to American authors, subtotal resection of the posterior ganglion is the method of choice in the treatment of trigeminal neuralgia. Drutter suggests that the practice of injection should be reserved for patients whose general condition does not justify a major operative procedure. Younger patients should be treated, as far as possible, by operative intervention, to avoid the possibility of keratitis.

EDITOR'S ABSTRACT [J A M A]

UNILATERAL EXOPHTHALMOS IN NEUROLOGIC CONDITIONS JACQUES LEY, *J belge de neurol et de psychiat* 36 669 (Nov) 1936

Ley discusses the diagnostic value of unilateral exophthalmos when local causes, such as ocular or otologic conditions, and general causes, such as exophthalmic goiter, Recklinghausen's disease, Schuller-Christian disease, Hodgkin's disease, leukemia, acromegaly and infantile scurvy, have been eliminated. In the majority of cases unilateral exophthalmos due to neurologic conditions is secondary to tumor of the brain. Other causes are thrombosis of the cavernous sinus or the jugular vein, the syndrome of the cervical portion of the sympathetic trunk, cerebral and epidural abscess, aneurysms of the cerebral arteries, certain congenital malformations, cranial trauma, meningeal hemorrhage, subdural hematoma, meningitis, oxycephaly, internal hydrocephalus and disease of the sphenoid fissure.

Finally, in rare cases transitory exophthalmos develops after epileptic crises or in association with abnormalities of posture, these conditions, in spite of their rarity, are difficult to interpret

Unilateral exophthalmos is sufficiently marked to be of diagnostic importance in from 1.5 to 2 per cent of all cases of cerebral tumor. Exophthalmos, unilateral and bilateral, is seen in from 8 to 10 per cent of cases of tumor of the brain. Unilateral exophthalmos may occur in association with intracranial tumor of any location but most frequently with tumor of the base of the brain or of the frontal lobe. A tumor just posterior to the orbit or in the region of the sphenoid fissure often produces exophthalmos. The condition is not as frequent in association with tumor of the temporal lobe, but it may occur, either with or without invasion of the orbital cavity by the neoplastic mass. Exophthalmos is more rare in connection with lesions of the parietal or the occipital lobe or of the cerebellum or the brain stem. In most cases the exophthalmos is on the side of the lesion, contralateral exophthalmos is seen occasionally in cases of tumor of the cerebellopontile angle.

Exophthalmos is most frequent in association with meningiomas and cranial hyperostoses, especially with meningioma of the sphenoid ridge or osteoma of the orbitoethmoid region. Venous or arteriovenous angioma is frequently accompanied with exophthalmos. Gliomas rarely cause unilateral exophthalmos, except those of the optic chiasm or the optic nerves. Unilateral exophthalmos is occasionally seen in association with neoplasms of the region of the hypophysis or of the third ventricle.

The cause of the exophthalmos in cases of intracranial neoplasm is usually direct pressure on the globe by the neoplastic tissue or proliferated bone. Other factors include venous stasis, usually secondary to pressure on the cavernous sinus or the ophthalmic vein, irritation of the sympathetic nerves and paralysis of the extraocular muscles.

WAGGONER, Ann Arbor, Mich. [ARCH NEUROL & PSYCHIAT]

#### THERAPY OF CHRONIC SUPPURATIONS OF FRONTAL SINUS W. KRAINZ, Monatschr f Ohrenh 70 1066 (Sept) 1936

Krainz maintains that suppuration of the frontal sinus is almost never restricted to that sinus but involves also the ethmoid and frequently even the sphenoid sinus. For this reason he discusses the treatment of chronic inflammation of the upper nasal sinuses. He says that at the clinic in Innsbruck, Austria, the endonasal operation of Halle is employed for this condition. However, the author does not begin, like Halle, by cutting around the sphenoid, after forming Halle's flap, he removes the ridge of the nose and exposes and enlarges the entrance to the frontal sinus. After describing the rest of the operation, he discusses the results, pointing out that in about 80 per cent of the cases the endonasal operation effected cure. In the remaining 20 per cent of the cases he counteracted the irritation of the nasal mucous membrane by inducing prolonged anemia, and he points out that Herzog employed this treatment in cases of rhinogenic retrobulbar neuritis. The author induces the anemia by inserting into the nose daily for three hours strips of gauze that have been saturated with a mixture of a 0.1 per cent solution of epinephrine and a 5 per cent solution of ephedrin. This treatment is continued until the swelling and the secretions of the mucous membrane disappear, which is usually after from one to two weeks. This conservative measure spares the patient another surgical intervention. Moreover, in the case of some nasal disturbances, even the chiefly polypous forms, the anemia counteracts the changes without surgical intervention.

EDITOR'S ABSTRACT

#### NOSEBLEED IN INFECTIOUS DISEASES, PARTICULARLY IN TUBERCULOSIS B. FREY-STADTL, Monatschr f Ohrenh 70 1071 (Sept) 1936

In the laryngorhinologic examination of patients with pulmonary tuberculosis, Freystadtl observed frequently smaller or larger crusts of blood in the nose. In

answer to the question whether nosebleed is frequent, the patients usually reply that profuse nosebleed does not occur but that they frequently find streaks of blood in their nasal secretion. The author found signs of nasal hemorrhage associated with mild as well as with severe pulmonary tuberculosis, the incidence being approximately 30 per cent. For measles, scarlet fever, sepsis and typhoid the incidence of nasal hemorrhages was not quite as high as it was for pulmonary tuberculosis. In discussing the cause of the nasal hemorrhages associated with infectious diseases, the author analyzes various possible factors, such as changes in the vascular wall, perfusion of nasal blood, the number of thrombocytes, the bleeding time, the coagulation time and the sedimentation speed, but he found no abnormalities which would explain the nasal hemorrhages.

EDITOR'S ABSTRACT

CRYOTHERAPY IN TUBERCULOSIS OF MUCOUS MEMBRANE H. ESCHWEILER, *Ztschr f Hals-, Nasen- u Ohrenh* 41 129, 1936

Eschweiler says that cryotherapy of the mucous membrane of the upper part of the respiratory tract, which was first recommended by B and F Teebrugge and by Nussbaum, has been employed at the clinic in Leipzig, Germany. For cryotherapy of the larynx, an improved form of F Teebrugge's laryngocryocautery was used. More than one year's experience with this method revealed to the author that cryotherapy gives the best prospects of success in cases in which the lesions on the oral and the pharyngeal mucosa are not too extensive. In these cases it is possible to obtain cicatrization without impairing the function of the movable parts (velum palatinum). In cases of isolated ulceration of the epiglottis, cryotherapy likewise promises favorable results. Moreover, freezing is helpful in combating the pain in edematous or ulcerous tuberculosis of the epiglottis, although cicatrization cannot be expected in these cases, because the arytenoid region and the aryepiglottic folds are usually involved. Cryotherapy is not advisable in cases of perichondritis of the arytenoid cartilage and of closed infiltrates on the posterior wall of the larynx.

EDITOR'S ABSTRACT

TREATMENT OF PULMONARY SUPPURATIONS WITH HYPERTONIC SALT SOLUTION R. S. BERKMAN and V. M. DOKSHIZKAYA, *Vrach delo* 19 1069 (Dec) 1936

Twelve patients with pulmonary suppuration were treated with intravenous injections of hypertonic saline solution. About nineteen injections were given to each patient. In each of 9 patients roentgen examination showed a large cavity (12 cm. in diameter in 1 case). Under the treatment mentioned, each patient's temperature became normal, and the sputum and odor, as well as the cavity, disappeared. Each patient gained from 4 to 19 Kg. One patient died, but the others have maintained their working capacity up to date. No exacerbation of the process was noticed in any.

The authors believe that their observations allow them to recommend intravenous injections of saline solution for pulmonary suppuration. They likewise point out that this method has the advantage of being safe and practicable under any condition.

BODER, Los Angeles [AM J DIS CHILD]

# Society Transactions

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## COLLEGE OF PHYSICIANS OF PHILADELPHIA, SECTION ON OTOLARYNGOLOGY

DR CURTIS C EYES, *Chairman*

*Oct 20, 1937*

DR WILLIAM HEWSON, *Clerk*

DR GEORGE L WHELAN, *Recorder*

### VINCENT'S INFECTION OF THE MOUTH, THROAT AND LARYNX REPORT OF A CASE DR A J WAGERS

In an unusual case of Vincent's infection, the local lesions at first resisted all treatment and spread to such an extent that the patient's life was endangered. The patient finally recovered. As this condition is most commonly not serious and responds readily to treatment, a report of the case appears justifiable.

The patient, a young man aged 17, had a slight cold, which was followed by soreness of the throat, the mouth and the gums. After a few days, ulcers appeared on the base and the sides of his tongue, and an abscess developed on his ankle. As local measures failed to bring relief, he became weak, lost about 15 pounds (6.8 Kg) and had difficulty in talking and swallowing. His tonsils had been removed. In 1932 he had been in the hospital for about six weeks because of anemia, loss of weight, jaundice and weakness. When I saw the patient he was pale and sallow, but there was no jaundice. Examination revealed about ten small and one large ulcer on the tongue and a fairly large ulcer on the posterior wall of the oropharynx. No membrane was visible. There was a slight tender swelling in the right submaxillary gland. As the blood count showed no leukopenia, agranulocytic angina was not suspected.

Cultures of material from the ulcers on the tongue yielded *Streptococcus haemolyticus*, and culture of material from the ulcer on the ankle, *Str. haemolyticus* and *Streptococcus aureus*. Smears from the lingual ulcers revealed Vincent's organism. The infection was therefore taken to be a mixed type, caused by Vincent's organism and streptococci. A slight improvement followed the use of an antiseptic mouth wash and local administration of neoarsphenamine in glycerin. Peruvian balsam was applied to the ankle. Ten days after admission, liver therapy was begun. Silver nitrate was applied to the lingual ulcers, but they did not improve. The patient's voice became weaker and finally hoarse. His temperature remained between 100 and 102 F, and the condition of the blood was about the same. He gradually became worse, the lingual lesions enlarging. A herpetic eruption appeared on the scalp. Finally he was given a blood transfusion. However, complete aphonia soon developed. An ulcer covered with a blackish exudate appeared on the right side of the hypopharynx. The general appearance of the throat suggested agranulocytic angina, but the white blood cell count was still 9,600. The neck became infiltrated and sensitive to pressure. Slight improvement followed intravenous administration of neoarsphenamine and repeated blood transfusion. The patient coughed frequently, and there was abundant expectorate, but no Vincent's organisms or acid-fast bacilli could be demonstrated in the sputum. He began to improve and was soon eating and sitting up, and the lesions were subsiding. Between the fourth and the fifth week after admission, however, in spite of the general improvement, marked leukopenia (1,900 leukocytes) was noted. He was given 10 cc of pentnucleotide, and the blood transfusions were continued.

Finally his voice returned, and slowly the lesions on his tongue and his ankle cleared. A roentgenogram of the chest suggested early bronchiectasis. A new crop of ulcers of more superficial type appeared on his tongue but soon responded to 10 per cent mild protein silver. In all, it had taken five months to get rid of the infection of the mouth and the throat, and the leukopenia developed long after the general and local condition had improved. The case illustrates the value of the intravenous administration of neoarsphenamine in the treatment of Vincent's infection, the supportive value of blood transfusions and the favorable response of leukopenia to pentnucleotide.

#### NEW METHOD OF OPERATION FOR CONGENITAL ATRESIA OF THE POSTERIOR NARES DR JOSEPH C DONNELLY

This paper appears in full in this issue of the ARCHIVES, page 112

#### REPORT OF A CASE OF OTITIC MENINGITIS DR D N HUSIK

Aside from a few recent cases, recovery from streptococcic meningitis has been almost unheard of.

A boy aged 5½ years was admitted after suffering pain in his left ear for forty-eight hours. He had suffered from running ears after an attack of measles and pneumonia at the age of two years and had been asthmatic since his third year. The diagnosis at the time of admission was infection of the upper part of the respiratory tract, with otitis media on the left. Consultation four days later revealed bilateral otitis media, and bilateral incision yielded pus. A zygomatic swelling developing within the next few days was attributed to zygomatic perforation, and roentgen examination revealed the presence of bilateral acute mastoiditis. Mastoidectomy was performed ten days after admission. Exposure of the dura revealed no pathologic condition. On the first day after operation the child complained of frontal headache. He vomited repeatedly, and his temperature went up to 104 F. On the following day he appeared toxic, dehydrated and acidotic, with nuchal rigidity and bilateral Kernig's sign. A blood count showed 58 per cent hemoglobin and 27,000 leukocytes, with 98 per cent polynuclears. Culture of the spinal fluid, which was cloudy and escaped under pressure, yielded hemolytic streptococci. Cultures of material from the mastoid likewise yielded this organism.

Repeated spinal drainage and transfusion were used, with drainage of the subarachnoid space. As continuous spinal drainage on a Bradford frame proved difficult, the drainage was repeated at intervals of eight hours. The child was given continuous venoclysis with 5 per cent dextrose solution and 5 cc of a derivative of sulfanilamide known as prontosil soluble (the disodium salt of 4-sulfamido-phenyl-2'-azo-7'-acetyl-amino-1'-hydroxynaphthalene-3',6'-disulfonic acid) intramuscularly and 5 grams (0.32 Gm) of sulfanilamide by mouth every four hours. Four days after the mastoidectomy the mastoid was reopened and the dura explored. Two long incisions were made for drainage. Mercurochrome was given intravenously, but in spite of all efforts the child died. Autopsy revealed an organized exudate over the base of the brain, with small collections of pus in the cerebral sinuses and dilatation of the ventricles. The bone roof of the sphenoid sinus was softer than normal and may have been the cause of meningitis, although this was not suspected as the respiratory symptoms subsided. The entrance of the organisms into the meninges was probably through the venous system.

#### SPONTANEOUS RADICAL MASTOIDECTOMY DR C E TOWSON

Spontaneous radical mastoidectomy is extremely rare. I was unable to find a case in the available literature. In 2 cases partial spontaneous mastoidectomy has been described, in 1 following erosion by a cholesteatoma to form a fistula into the canal, and in the other in association with chronic mastoiditis, cholesteatoma and fistula into the external auditory canal. In the case presented here the result accomplished by nature was like that usually accomplished only by a thor-

ough radical operation, with complete removal of the tympanic membrane and ring, the posterior canal wall was entirely removed down to the level of the external semicircular canal, and the tympanum, the antrum and the mastoid were converted into one cavity, seen through the meatus of the canal

The patient, a man of 54 years, had suffered for eight years from chronic purulent otitis media on the right, with pain, total deafness on that side and vertigo. The left ear was unaffected. In 1926 he fell and bumped his head, and there were bleeding from the right ear and a discharge that lasted for a week. In 1935 he received a blow on the head, this was followed by discharge from the ear but no pain. He was given some drops of boric acid and alcohol to instil into his ear.

Examination on Jan 1, 1937, revealed inspissated foul pus and desquamated epithelium. When this was cleaned out, a small amount of granulation tissue was exposed in the tympanum. Audiometric tests revealed 73 per cent loss of hearing for speech on the right side and 38 per cent on the left. The Wassermann and the Kahn reaction were negative. Roentgen examination revealed a few mastoid cells on the left side, but the majority were destroyed. There was no evidence of mastoid cell structure on the right side. Malignant growth, tuberculosis and syphilis were ruled out. Most probably the phenomenon was due to cholesteatoma, since a small amount of cholesteatomatous material was found at one time in the cavity.

#### NASAL TEETH REPORT OF A CASE DR W J HITSCHLER

This paper will be published in full in a subsequent issue of the ARCHIVES

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DR CURTIS C EVES, *Chairman*

*Nov 19, 1937*

DR WILLIAM HEWSON, *Clerk*

DR GEORGE L WHELAN, *Recorder*

#### DIFFERENTIAL DIAGNOSIS OF BACTERIAL MENINGITIS OF AURAL AND OF NASAL ORIGIN DR JOSEPH C YASKIN

This paper was published in full in the April 1938 issue of the ARCHIVES, page 444

#### MEDICAL TREATMENT OF OTITIC MENINGITIS DR KARL M HOUSER

The medical treatment of otitic meningitis up to last year must be considered as a failure except in rare instances of recovery. Recent reviews of the literature have revealed no more than 76 recoveries in the last thirty-five years. Since the report of the first case of otitic meningitis to be cured with a derivative of sulfanilamide known as prontosis tablets (the hydrochloride of 4-sulfamido-2',4'-diaminoazobenzene), in 1936, 106 cases of recovery following the use of this drug or allied preparations have been reported. To date most of these cures have occurred in cases in which the infection was with hemolytic streptococci, but recently it has been claimed that pneumococcal infections will respond to this treatment. Prontosil and sulfanilamide have both been used with a certain amount of success in the treatment of hemolytic streptococcal infections of all types, but the mode of action of these complex chemicals is not fully understood, in the test tube their bactericidal action is slight. Bliss and Long believe their effect to be inhibitory and/or bacteriostatic, retarding the growth of the bacteria and permitting phagocytosis to keep pace with bacterial proliferation. Large doses by various routes prove effective. The drugs have been given by mouth, subcutaneously, intramus-

cularly and intrathecally. From the increasing number of reports of untoward reactions, it is obvious that their use should be carefully supervised and their effects constantly observed.

#### SURGICAL TREATMENT OF OTITIC MENINGITIS DR WALTER ROBERTS

Advances in the therapy of otitic meningitis have yielded an increasing number of cures, so that prognosis is no longer so hopeless as formerly. Although diffuse purulent leptomeningitis is still inevitably fatal, owing to the complete absence in this form of any tendency toward formation of limiting adhesions, reports of recovery from the circumscribed purulent type of leptomeningitis and from serous meningitis are accumulating. As differential diagnosis between the three types is practically impossible in the early stages of the disease, treatment is instituted promptly in all cases. In fact, the success of treatment depends on its earliest possible application. Immediate spinal puncture is indicated, with removal of only sufficient fluid for examination, as withdrawal of larger amounts may favor spread of the infection. An increased cell count in the spinal fluid indicates immediate operation, a complete simple mastoidectomy in cases of acute disease or a radical operation if the acute attack has been preceded by a chronic otic discharge. After the usual mastoid procedures, the dura of the middle and the posterior fossa should be widely exposed and all diseased bone in contact with the dura removed.

Opinions differ as to the optimum time for incision of the dura. Whereas G. E. Shambaugh, Jr. has expressed the belief that dural incision is indicated only after development of generalized meningitis, James Adam and E. A. M. Connal, of Glasgow, Scotland, advocated prompt incision, on the basis of their remarkably successful series of 7 cures in 9 cases. I advise waiting twenty-four hours before incision because, in my experience, within this period sufficient improvement to render incision superfluous sometimes occurs. Two illustrative cases are cited, in both of which the symptoms evidently were due to serous meningitis and in which immediate relief followed eradication of the focus of infection.

In both cases the disease was circumscribed purulent leptomeningitis and the patient a youth of 17 years. In the first case meningitis due to *Pneumococcus* type III followed a simple mastoidectomy. The focus of infection was destroyed by reopening of the mastoid and removal of the tegmen, the antrum and the tympanum with 1 square inch (64 sq. cm.) of the squamous plate, spinal taps, specific antiserotherapy and blood transfusions were employed. The patient was discharged cured on the forty-seventh day. In the second case meningitis due to *Bacillus proteus* followed removal of polyps. Radical mastoidectomy disclosed polypoid degeneration of the mastoid tip, with erosion into the middle fossa. After removal of the focus of infection, subarachnoid drainage and blood transfusions, the patient was discharged on the twenty-eighth day. In this case spinal taps were employed twice a day for the first two days, and pressure was maintained in the spinal fluid for the next six days by means of the indwelling spinal puncture needle. Bacteria and pus in the spinal fluid do not necessarily imply a diffuse process.

#### LANTERN SLIDES OF ANATOMIC SPECIMENS DR ADDINELL HEWSON

#### RHINOGENIC MENINGITIS DR GEORGE M. COATES

Dr. Wells P. Eagleton in a recent communication stated that the surest way to cure meningitis is to prevent it. With this point in view I shall briefly mention certain anatomic pathways through which infection may be a cause of rhinogenic meningitis. The members are all familiar with the so-called butterfly area of the nose. This area bounds the upper lip and passes upward and outward alongside the ala nasi and thence to near the outer canthus. Its configuration resembles that of a butterfly, hence the name. This area is important clinically, for the veins here do not drain into the external jugular vein, but take a different course. The minute radicles empty into the angular, the common facial and the inferior and the

superior ophthalmic vein and finally into the cavernous sinus. Thus, any pyogenic infection in this area might gain ingress to the cavernous sinus and cause meningitis or septicemia. By the time the cavernous sinus has become thrombosed, the overwhelming septicemia usually causes death. Every infection here should be treated with the utmost conservatism, and no furuncles or boils in this area should ever be squeezed. Hot compresses or poultices of boric acid or magnesium sulfate, infra-red radiation and vaccines are the safest agents of treatment. The local infection should be left severely alone unless a white necrotic point is seen, when a sharp knife can be introduced so as to lift the necrotic spot and permit the core to come out. It should be remembered that thrombophlebitis of the cavernous sinus is 100 per cent fatal, even in the best of hands.

Another pathway of infection is by passage up the perineural sheaths of the olfactory filaments through the cribriform plate (Key and Retzius). This pathway is followed in cases in which the protective barriers of the nose have been broken down. Still another factor in the genesis of rhinogenic meningitis is any osteomyelitic process of the nasal accessory sinuses. Trauma, either direct or operative, may be an important cause. When intranasal operation is injudiciously performed meningitis occasionally becomes the final issue.

Eagleton has stated that in far the larger proportion of cases abscess of the brain and meningitis are caused by passage of the infective process by way of infective retrograde thrombophlebitis and not by direct extension of the suppurative process. The venous tributaries of the accessory nasal sinuses are rich, the maxillary, the ethmoid and the sphenoid veins drain down the pharyngeal veins in the neck, whereas the frontal veins drain intracranially, as Zwillinger and others have shown. Indeed, the intimate relation in the supply of blood and of lymph between the frontal sinus, the bone and the dura explains at once how frontal sinusitis could lead to an intracranial involvement. The maxillary sinuses are the least likely to cause meningitis and the ethmoid, the sphenoid and the frontal sinuses most likely.

With these principles in mind, I can say that early and accurate diagnosis, based on a complete history, a careful examination, anatomic, physiologic and pathologic analysis of the problem and the use of such laboratory aids as will shed further light on obscure points, will go far in preventing dangerous intracranial sequelae. Adequate aeration and drainage of all the accessory sinuses should be the first aim. This may require correction of septal deviations, spurs, hypertrophies and hyperplasias, as well as suitable medication to keep the turgid mucosa occasionally constricted. Lymphoid elements in the fauces and the nasopharynx may have to be removed. It is most important that the sinuses be drained thoroughly and effectively. All radical sinusal operations should be gently and carefully carried out. Often a thorough clean-up can go far toward producing recovery if the diagnosis is made early enough. Osteomyelitic processes may call for conservative or operative measures, the latter to remove the infected or devitalized bone for a distance of about 2 inches (5 cm.) beyond the osteomyelitic area. The general trend of opinion today is that this work should be from the clean to the infected area. The conservative method includes every means whereby the economy is brought up to the highest possible state of nutritional efficiency. In all this it is of the utmost importance that there be the closest cooperation between rhinologist, ophthalmologist, neurologist, internist, neuro-otologist, radiologist and neurosurgeon.

The rhinologist works through an infected area, cleans out the original focus of infection in the sinus (or the ear) and then traces the pathway from the first focus of infection to secondary foci that may have been established in the intracranial structures. All foci of infection are drained. During the search an extradural abscess may be discovered. If so, free drainage should be provided at once, or serious consequences may follow.

Therapy for rhinogenic meningitis consists of thorough drainage of the infected sinus and the subarachnoid space. Time will not permit further remarks concerning definite technic, except the statement that after adequate drainage of the sinus has been provided, the subarachnoid space should be drained continuously by lum-



bar or cisternal puncture All supportive measures, such as blood transfusions, should be used and medication with sulfanilamide orally and with a derivative of sulfanilamide known as prontosil (the disodium salt of 4-sulfamidophenyl-2'-azo-7'-acetylamino-1'-hydroxynaphthalene-3',6'-disulfonic acid) intramuscularly, which recently seem to have had promising results, used judiciously

#### DISCUSSION

DR HENRY DINTENFASS I divide cases of otitic meningitis into four groups In cases of the first group the cerebrospinal fluid contains organisms, the disease is fulminating, resists all treatment and ends in death In cases of the second group there are no organisms in the cerebrospinal fluid, but, owing to the intense virulence of the organisms, the patients die of the toxins produced In such cases the organisms give no growth on culture In cases of the third group the cerebrospinal fluid is likewise free from organisms, but the infection is mild, and with proper treatment the patient recovers In cases of the fourth group the cerebrospinal fluid contains organisms but of a less virulent type than in the first group, so that recovery is not excluded I have observed 3 cases of the last group in which recovery was attributed to the procedure outlined by Dr Roberts, including prompt, thorough mastoidectomy, incision of the dura twenty-four hours later, elevation of the foot of the bed to permit gravity drainage of the cerebrospinal fluid and packing of the wide open mastoid wound At reoperation forty-eight hours later more bone was removed and another dural incision made anterior to the first The dural incisions must cut across the sulci between convolutions to insure free drainage and must not be too long or too close together One of the pathways of infections in cases of otitic meningitis is through the middle fossa near the petrous tip The policy of leaving the operative field wide open applies principally in cases of otitic meningitis In cases of meningitis of nasal origin adequate drainage is often anatomically impossible The essential treatment in cases of otitic meningitis is to remove the focus of infection in the mastoid or the temporal bone in contact with the dura I have not had success with the Kubie treatment of meningitis, and I feel that the danger of edema of the base of the brain outweighs any advantages it may have to offer It seems logical to assume that institution of drainage near the site of origin of the infection would be of greater advantage than lumbar puncture, which so often leads to spread of infection, owing to release of pressure Regardless of the type of causative organism, sulfanilamide or a similar preparation should be tried in conjunction with other methods of treatment

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DR CURTIS C EVES, *Chairman*

*Dec 15, 1937*

DR WILLIAM HEWSON, *Clerk*

DR GEORGE L WHELAN, *Recorder*

#### THE NEW LOCAL ANESTHETICS IN OTOLARYNGOLOGIC PRACTICE DR M VALENTINE MILLER

Used alone, the new synthetic local anesthetics give results less satisfactory than cocaine, even though they are considered safer When they are combined with epinephrine, the danger of intoxication is diminished and the duration of anesthesia increased, because epinephrine retards absorption The toxic effect of the synthetic drugs is dependent on the rate of absorption rather than on the quantity of the drug administered It must be kept in mind that, whereas cocaine is a cerebral stimulant and overstimulates the respiratory centers, the synthetic preparations, with the exception of tutocain, are depressants The symptoms of intoxication by the latter include pallor, sweats, a tendency to fainting, nausea

and vomiting, associated with a weak pulse and shallow respiration, which occur as a rule when the head is lowered. In cases of extremely severe disease paralysis of the respiratory tract or cardiac failure due to direct action of the drug on the cardiac muscle may ensue. As a rule, artificial respiration and circulatory maintenance will lead to recovery. Circulatory stimulants accelerate the passage of the blood containing the drug to the liver, where detoxication occurs. Massage of the heart, or even injection of epinephrine into the heart, may be of aid. In the presence of air hunger, the inhalation of oxygen is indicated, and intravenous injection of coramine (a 25 per cent solution of pyridine betacarbone acid diethylamine) may be used to stimulate respiration and circulation. Owing to the fact that these synthetic anesthetics are already depressant, the administration of derivatives of morphine and of barbituric acid is contraindicated. The number of fatalities due to synthetic local anesthetics is low, but it must be kept in mind that some of these deaths may be attributable to idiosyncrasy.

In susceptible subjects epinephrine may cause palpitation, vomiting, excitement, tremor and anxiety, and in cases in which the involvement is severe, diarrhea, hematuria, ascending paralysis, fall in temperature, convulsions and death. In cases of serious cardiac disease as little as 0.4 cc of a 1:1,000 solution of epinephrine hydrochloride may prove dangerous. This drug is of special danger in the presence of hyperthyroidism. To exclude hypersensitivity, a preliminary test injection of from 0.2 to 0.3 cc should be given.

To prevent toxic manifestations, these synthetic local anesthetics should not be given to patients with pulmonary or cardiac disease except in carefully selected cases, and then only in combination with proper supportive treatment to combat their depressant action. Test injections of the solutions or conjunctival tests should be made to exclude hypersensitivity. Cutaneous tests are unreliable for this purpose. Hypersensitivity to epinephrine must be ruled out but is fortunately rare. The injections should be given with the patient in the reclining or the semireclining position, and preliminary administration of sedatives is contraindicated. Before the fluid is injected, the plunger of the syringe should be withdrawn, to make sure that a vein has not been entered.

These anesthetics may be applied by injection or topically. By injection the epinephrine may be given first or together with the anesthetic. I prefer to give the epinephrine first. Among the more slowly soluble anesthetics for topical application, are ethyl aminobenzoate, orthoform, butesin and butesin pierate. Among soluble anesthetics are procaine hydrochloride, pontocaine, nupercaine, tuteocain, larocaine hydrochloride, metycaine, alypin, butyn, apothesine and benzyl alcohol. Some of the less well known ones include dithane hydrochloride, phenacaine hydrochloride and procaine borate.

I have had personal experience with pontocaine, larocaine hydrochloride, nupercaine and butyn. For the past two years I have used pontocaine almost exclusively for topical application and procaine hydrochloride for injection.

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DR CURTIS C EYES, *Chairman*

*Jan 19, 1938*

DR WILLIAM HEWSON, *Clerk*

DR GEORGE L WHELAN, *Recorder*

#### LARGE PROTRUDING OR PROLAPSED EARS ANATOMIC CONSIDERATIONS AND SURGICAL CORRECTION DR WARREN B DAVIS

Large protruding or prolapsed ears are congenital deformities in which the dominating abnormality is a deficiency or even an absence of the antihelical fold. The type of ear worn has no etiologic or therapeutic significance except as a

postoperative measure Embryologically, the auricle arises from six elevations, variations in the development and fusion of which determine the primary contour of the ear The normal range of aural contour is fairly wide, and the size and the shape of the ear, whether normal or pathologic, may be inherited In a few cases abnormally prominent ears are of normal shape but have an abnormal attachment to the head, but in by far the majority of cases there is abnormality of the ear itself

Plastic surgery is indicated in cases in which the deformity is sufficient to be a detriment in the search for employment or to affect the psyche of the patient Monks' operation is applicable only to slight deformities The best operations of today are founded on the basic principle emphasized by Luckett that an antihelicine fold must be established to secure a satisfactory cosmetic result With near normal contour restored and a 30 degree cephaloauricular angle established, the ear ceases to be conspicuous, even if a little larger than normal I do not consider through and through excisions of skin and cartilage indicated for reduction of size only Dressings should be applied to hold the ear in overcorrection for a few days Bandages are used for two weeks to aid the union of the cartilaginous margins, and a light elastic cap is worn at night for a month or six weeks

Results were most gratifying in all cases in which the Luckett operation or a modification was used, not only because of the cosmetic effect but because of the marked change in mental attitude and psychologic outlook of the patient

#### PRIMARY MELANOMA OF THE NASAL CAVITY TWO CASES DR AUSTIN SMITH

By reporting 2 cases of melanoma of the nasal cavity, I am bringing the number reported in the English literature up to 14

CASE 1—A white woman of 60 years was admitted for recurring epistaxis from the left nasal chamber Examination revealed a small soft red wartlike growth springing from the floor of the left nasal chamber just beyond the vestibule, this was removed with a snare and its point of attachment cauterized Histologic examination revealed a melanoma of apparently but not definitely malignant type Sixteen months later removal of a nodule in the submaxillary region was followed by postoperative roentgen treatment because of histologically suspected malignant growth No pigment cells were noted Two years later tinnitus and deafness in the left ear developed, and two weeks later double vision and disturbance of balance followed The patient's condition was diagnosed as intracranial metastasis in the left cerebellopontine angle from malignant tumor in the submaxillary region She became rapidly worse and died in coma within six weeks Slides from the nasal tumor and from the submaxillary tumor were found to be histologically identical except for the absence of pigment in the latter Death was undoubtedly due to intracranial metastasis from the primary nasal growth

CASE 2—A man aged 35 years complained of obstruction of the right side of the nose of four months' duration Polyps had been removed from this region because of obstruction three years before Examination revealed a granular growth involving the anterior tip of the right inferior turbinate, attached by a pedicle with rather a broad base This was removed with a snare under local anesthesia Histologically it was considered to be a form of granuloma Biopsy following local recurrence sixteen months later revealed carcinoma, radical operation was advised but refused Ten months later a nodule appeared at the angle of the jaw After ligation of the right external carotid above the superior thyroid artery and removal of the submaxillary node, a Rouge or Denker operation was performed on the right side The growth had extended by continuity to the nasointral wall and the ethmoid area without extensive involvement of the sinuses Histologically the cells of the submaxillary node were similar to those of the primary growth

but showed definite pigmentation. The diagnosis was melanoma. A few months later an acute abdominal condition developed, which proved to be intestinal obstruction due to thrombosis of the mesenteric vessels by tumor cell emboli. The cells were identical with those of the previous slides and showed scattered pigment. When last heard from, the patient was declining rapidly, with generalized metastasis. Roentgen therapy had no effect.

There are various theories of the origin of these tumors. Ordinarily, malignant melanoma is thought to have its origin in a nevus of the cutaneous surface, but it may develop from misplaced tissue or cell rests in the mucous membranes. The presence of pigment confirms the diagnosis, but its absence does not exclude melanoma. Considering the slow growth of the primary lesion and the extremely rapid dissemination of the metastases, I believe it probable that complete removal of the tumor with a wide margin of normal tissue would offer an excellent chance of cure. In cases of tumor of the anterior part of the nasal cavity, lateral rhinotomy or the Roux or Denker operation may be indicated. In handling malignant tumors of this region, a physician must make careful histologic study of the tumor before a proper plan of treatment can be formulated.

#### PARENTERAL ADMINISTRATION OF CERTAIN SUBSTANCES IN TREATMENT OF INFECTIONS OF THE UPPER PART OF THE RESPIRATORY TRACT. DR. GEORGE M. COATES, DR. WARREN B. DAVIS and DR. WILLIAM GORDON

Manifold etiologic factors must be looked for and considered by the laryngologist in the motley group of cases of nasal dysfunction encountered in daily practice. Much of the recent progress in laryngologic practice is attributed to a more thorough realization of the influence of systemic disturbances on laryngologic conditions and vice versa. In the treatment of these conditions much importance is attached to personal hygiene and correct diet. The employment of suitable stock vaccines, of doses of 3 units of insulin and of compound solution of iodine in doses of 3 drops, nonspecific protein therapy and similar measures are added for the purpose of stimulating defensive mechanisms and metabolism. In some cases cooperation of the internist is invited in the hope of improving results.

In some cases in which there are fair to good intranasal mechanics the most refractory conditions with mucosal intumescence and excessive postnasal secretion respond to oral administration of calcium, strychnine sulfate, thyroid, atropine sulfate, dilute hydrochloric acid, sodium bicarbonate, sodium chloride, phenobarbital, ephedrine sulfate and similar agents.

For a long time we have been under the impression that parenteral administration of various substances might be of aid in treating the more refractory conditions. Among the substances considered for this purpose were camphor, menthol, iodoform and iodides in an oil vehicle. The effects of these drugs on respiration, circulation and metabolism were reviewed. Parenteral administration of these substances has given good results in the treatment of hay fever, asthma and sinus infection. In the cases here under discussion, a combination of the drugs mentioned seemed desirable, in order that their full value might be realized. Finally a standardized commercial product consisting of 2 per cent camphor, 4 per cent menthol, 1 per cent iodoform and 0.1 per cent antimony in peanut oil was selected for the purpose. It is supplied in sterile ampules in accurately measured doses. In the majority of cases the injections were given intramuscularly, but from recent experiments it appears likely that subcutaneous administration will prove just as efficacious. The injections were made at varying intervals according to individual indications. In cases of acute involvement there was improvement after one or two injections, while chronic disease resisted longer. Although the series studied comprised various types of acute, subacute and chronic sinus involvement, including some of allergic and of vasomotor origin, and this paper is offered not as a scientific contribution but as a preliminary report, the results indicate that the method merits further trial, at least as an adjunct to approved and tested procedures. It offers no substitute for surgical methods but

may well contribute to their success. Best results were obtained in the treatment of acute disease and of acute exacerbations of low grade chronic sinusitis, though in some cases chronic disease associated with minor endocrine imbalance responded nicely. The intervals between injections in cases of acute disease were of three or four days and in cases of more chronic disease of one or two weeks. Gratifying results were obtained in 32 per cent of the cases, beneficial results in 30 per cent, uncertain findings in 36 per cent and unsatisfactory results in 2 per cent. The series included 284 cases in which the disease had previously resisted other routine treatment.

#### DISCUSSION

DR GEORGE M. COATES. We have had a certain number of favorable results. The injection of this preparation is practically painless, and only 1 patient told me that the pain was most severe. However, this patient always complained about everything. When I wiped his nasal fossa with some weak shrinking solution, he complained bitterly to me that this was most painful. This preparation merits further use, and it is not unlikely that some more favorable results will be observed. It is my impression that in some cases of sinus disease associated with endocrine imbalance there has been improvement. I want to ask the chairman if he would be kind enough to call on Mr. Lichtin, who has given us much help in chemical matters and in materia medica.

AARON LICHTIN, PH.G. The preparation is a harmonious one. The peanut oil has a low acid curve, is highly bland and is apt to be in a purer state than other oil vehicles. Peanut oil is widely used as an oil vehicle. The antimony iodide is a stabilizer to hold the camphor and the iodoform.

DR WILLIAM GORDON. It is necessary to reiterate that the cases of acute disease and of acute exacerbation of chronic disease used in this study, in which we had gratifying results, were those in which the condition was refractory. It is possible that a patient with acute disease would get well anyway, but our group generally comprised patients who were slow in getting well. We wanted to hasten the recovery generally, which was our reason for adding the use of this parenteral preparation to our routine. Patients presenting hyperplastic changes did not, in our series, benefit from this preparation. We felt that hyperplasia represented further progress in the histologic picture—an irreversible change, so to speak—and was not amenable to local conservative treatment, even with catalytic adjuvants.

Dr. Donnelly brought up an interesting point with reference to iodine sensitivity. When such a manifestation is encountered and an injection causes allergic manifestations, no further injection should be given. The subject should be tested by the allergist (as indeed all allergic subjects should) and other agents suitable to him utilized. Any allergic subject who is not sensitive to the medicaments in this preparation may receive the therapy advocated. It should be remembered, however, that the drug is not a cure-all but merely an adjuvant to tested agents.

#### EARLY ATTENTION TO THE LARYNX IN TUBERCULOUS PATIENTS DR. ROBERT M. LUKENS

Except in sanatoriums and clinics for patients with tuberculosis, in which examination of the nose and the throat is a routine procedure in all cases of pulmonary tuberculosis, invasion of the larynx by tuberculosis is usually well under way before it is recognized, and treatment is rarely begun until long after the onset of this complication. As successful treatment of laryngeal tuberculosis depends largely on its early application, early diagnosis is of the utmost importance. I believe that prior to the lodging of the tubercle bacillus in the submucosa there has been a denudation of epithelium due to inflammation. The regeneration of epithelium over the implanted organism results in a histologic tubercle. Proper treatment at this time may heal the tubercle. If the larynx is not in good condition, the tubercle may develop, with eventual caseation and ulceration. Pyogenic invasion of this ulceration leads to further extension of the lesion. Both tubercu-

lous and pyogenic ulcers may be present. The tuberculous lesions may spread to the deeper structures, with resulting chondritis and perichondritis, often leading to complete destruction of the epiglottis and the arytenoid cartilages.

In the early stages of tuberculosis of the larynx there are few symptoms except slight cough due to irritation and the gradual onset of hoarseness. By the time dysphagia and constant hoarseness have developed there is little hope of cure or relief. Epiglottic lesions and lesions of the arytenoid cartilages with pseudoedema cause dysphagia. The probability of cure diminishes as the disease progresses. A progressing laryngeal lesion has an unfavorable effect on existing pulmonary lesions, and diminished resistance to the laryngeal process results, thus forming a vicious circle. An improving pulmonary lesion is no indication that the larynx is free from disease or that existing laryngeal disease is improving. Early and periodic laryngeal examination is therefore indicated from the beginning of pulmonary disease.

The mortality rate of pulmonary tuberculosis is gradually decreasing, owing to efforts to conquer the disease in its earliest stages, and a similar program would have a similar effect on the statistics of laryngeal tuberculosis. All patients with pulmonary tuberculosis should be under the care of both an internist and a laryngologist from the beginning of the disease. Infections of the respiratory tract should be cleared up. If proper attention is paid to the nontuberculous infections of the upper part of the respiratory tract, there is no doubt that active tuberculous laryngitis could be prevented in many cases. Vocal rest is of value in prophylaxis of laryngeal inflammations, and education of the patient with regard to his larynx before laryngeal lesions appear is of great value.

#### DISCUSSION

DR GEORGE M. COATES. I recommend laryngeal examination at frequent intervals as a routine in cases in which the condition of the chest is suspicious. I should be pleased to know if Dr. Lukens is continuing the use of chaulmoogra oil and if he is pleased with his results. Does he observe many cases in which amputation of the epiglottis would be beneficial?

DR GEORGE L. WHELAN. I recommend laryngeal examination in all cases of pulmonary lesions. If the larynx appears suspicious examinations should be conducted more frequently. I have used Dr. Lukens' concentrated oil, modifying it by adding 1 grain (0.06 Gm.) of menthol and 2 grains (0.13 Gm.) of cocaine alkaloid to an ounce (29.6 cc.) of the oil. This, I believe, renders the oil more palatable to the patient and helps relieve the dysphagia. I try to have the patient expectorate the excess, as it is possibly irritating to the stomach and the taste is not too pleasant. It is possible that some patients who have not been helped by chaulmoogra oil have had it instilled into the esophagus. In some of the cases at the Eagleville Sanatorium for Consumptives, Eagleville, Pa., I have done a tracheotomy, which places the larynx at rest, have given Lukens' oil and, if necessary, have made injections into one or both the superior laryngeal nerves. Anything which may give relief to the patient should be tried.

DR ROBERT M. LUKENS. In answer to Dr. Coates's question regarding chaulmoogra oil, I wish to say that I still like it. Unquestionably, as Dr. Whelan states, it is irritating to the stomach, I ask the patients to expectorate the overflow. Recently I have not amputated the epiglottis. Occasionally I touch the edematous area on the epiglottis or the arytenoid cartilage with the cautery, using only one or two applications during each treatment. I have done a tracheotomy on only 1 patient with laryngeal tuberculosis. The larynx became well, but the patient later died. I prefer local applications and vocal rest. In answer to Dr. Donnelly's question I inject a 60 per cent solution of alcohol in 1 per cent procaine hydrochloride into one or both superior laryngeal nerves and repeat the procedure when dysphagia returns.

DEMONSTRATION OF SECTIONED SKULL, TO SHOW RELATIONS TO ACCESSORY NASAL SINUSES. DR. ADDINELL HEWSON.

DR CURTIS C EVES, *Chairman**Feb 16, 1938*DR WILLIAM HEWSON, *Clerk*DR GEORGE L WHELAN, *Recorder*

SULFANILAMIDE IN THE TREATMENT OF EXPERIMENTAL STREPTOCOCCIC AND PNEUMOCOCCIC MENINGITIS DR JOHN A KOEHLER, WITH THE ASSISTANCE OF ANNA M RULE and MARY L WERNER

This paper was published in full in the May 1938 issue of the ARCHIVES, page 519

SYMPOSIUM ON NEW THERAPEUTIC AGENTS AS APPLIED TO OTOLARYNGOLOGIC PRACTICE DR JAMES A BABBITT

I have selected ten important recent additions to the therapeutic armamentarium of the otolaryngologist, giving a brief review of results reported in the literature and some of my own experiences with their use. Here, as in other fields of medicine where infection plays a major part, sulfanilamide dominates the scene. Its otolaryngologic significance is manifested chiefly in the treatment of streptococcic and pneumococcic invasion of the tympanic, the mastoid, the sinusal and the oropharyngeal area.

Systemic shock or lowered resistance may serve to light up latent foci, and as the upper part of the respiratory tract and the otologic tract are numbered among the chief highways to the meninges, the indications for sulfanilamide are evident. A prophylactic application has been suggested. I have found that the periodic reaction after recovery from major streptococcic infection may be controlled by two or three days' administration of four 5 grain (0.32 Gm) tablets daily. In major crises following operation, life may be saved by prompt administration of sulfanilamide. Not infrequently in cases in which there are obvious surgical indications cure without intervention may follow well directed treatment with sulfanilamide.

It is important, too, that the otolaryngologist be aware of the danger signals of intoxication by sulfanilamide. Among the earlier signs, which disappear rapidly, may be mentioned reddening of the mucous membranes and the conjunctivas, a maculopapular cutaneous eruption, cyanosis of the lips, nausea, tinnitus and vertigo. The ultimate effects of overdose may be sulfhemoglobinemia and methemoglobinemia, or even agranulocytic angina. As a safeguard, a blood count should be made every other day, and when the leukocyte count shows a material drop the drug should be withheld until it returns to normal. The dose depends on the severity of the infection, the age of the patient and the duration of the disease. For adults, tablets may be administered every six hours to an average of 60 grains (3.88 Gm) for the first day, 40 grains (2.59 Gm) for two or three days and from 10 to 20 grains (0.65 to 1.29 Gm) for two or three days more. Large doses have been given to children without harmful effects. If methemoglobinemia should develop, oxygen should be administered, and in case of sulfhemoglobinemia, prompt blood transfusion is recommended.

Ephedrine has been found beneficial in the treatment of asthma and in some cases, of hay fever and of urticaria. I have found that its internal administration will afford striking release of the nasal passages without significant toxic effect. Topically, of course, it is used for shrinking the nasal passages and aiding sinusal drainage. The aqueous solutions are most effective and have little toxic effect. As regards ciliary influence, ephedrine seems to be the least harmful of the vasoconstrictors and does no such damage to the tissues as that observed after the use of epinephrine. Ephedrinum may prove effective in cases in which both epinephrine and ephedrine fail. Among the newer ephedrine-like substances used for topical application to the nasal mucosa, tetrandine methiodide, hordenine methiodide, benzyldimethylene methiodide and betaphenylethylamine all show experimental evidence that they irritate the ciliated epithelium.

In the treatment of headache of obscure origin a combination of epinephrine, cocaine and antipyrine is recommended, while in some cases borderline idiopathic migraine, especially of the red type, responds to administration of this preparation and of some alkaline, bromide and ergot preparations

Few antiseptic germicidal solutions have met with as much favor as metaphen. Used in 1 : 5,000 solution in the oropharynx, in solutions as strong as 1 : 500 applied locally in an infected middle ear and in combination with ephedrine in a watery shrinking spray for the nose, it has proved effective. Although without favorable results in cases of experimental septicemia due to pneumococcus or to *Streptococcus haemolyticus*, it has a high bacteriostatic action and a relatively low toxicity and is therefore, according to R. G. Douglas and K. E. Birkhaug, deserving of further clinical study. Reports from dentists have given an unfavorable impression of the use of weak solutions of metaphen on organisms in the mouth. I agree with other writers that the preparation has not replaced iodine.

Interesting results have been reported in the treatment of tinnitus and deafness in association with otosclerosis and of catarrhal deafness with injections of thyroxin into the middle ear, a treatment based on the passive congestion produced by this drug. Some results have been encouraging, others have not. In my own experience in 25 or 30 cases I have been disappointed, although I admit that this may have been due in part to the fact that the full series of six injections was not given in all cases. For anesthesia of the middle ear prior to injection of the thyroxin I have secured satisfactory results by application on a cone of cotton of a preparation containing oil of cloves, phenol, menthol, ethyl aminobenzoate and 22 per cent alcohol, followed by the use of 10 per cent procaine hydrochloride.

For relieving pain in the tonsillar fossae after tonsillectomy I recommend substitution of ethyl aminobenzoate for acetylsalicylic acid, which I believe retards healing. Insulin has been applied locally to stimulate granulation after tonsillectomy.

To check the pathologic crusting of the atrophic nose, intramuscular injections of an estrogenic substance in oil may be tried. Local application of estrogen is also recommended. I have made use of estradiol benzoate for this purpose.

In the treatment of subacute and chronic laryngitis nothing has given better results than mono-*p*-chlorophenol, suggested by Dr. Chevalier Jackson. It is dropped with a curved laryngeal syringe on the phonating cords.

Trichloroacetic acid in 25 per cent strength is recommended for control of septal hemorrhage without deep excoriation and as an aid to 10 per cent neoarsphenamine in antagonizing Vincent's angina.

Vitamins B and G have been tried in the treatment of varying degrees of both progressive adhesive and neural deafness, with one or two startling and several moderately pleasing results.

#### COMMENTS ON SOME OF THE RELATIVELY NEW DRUGS DR. WILLIAM EGBERT ROBERTSON

A slight change in the position of a radical on a nucleus may result in a material chemical and physiologic change in a product, as is true, for instance, of benzedrine, ephedrine, epinephrine and neosynephrine hydrochloride, which are all phenylalkylamine derivatives. Ephedrine is an alkaloid and epinephrine a biologic derivative. In the synthetic production of drugs, the drug is as efficient as the natural product if levorotatory, is inert if dextrorotatory and has about half the value of the natural product if optically a racemic compound. All four drugs mentioned possess the property of contracting the blood vessels when applied locally. They may therefore be used in combination with local anesthetics to prolong the effect of the anesthetic and retard absorption. In their other properties, such as their effect on blood pressure, on cardiac rate, on bronchial spasm and on the sugar content of the blood, these drugs differ, having either opposite effects or effects of varying degree. Their effect on the body, the mind and the sympathetic nervous system of different persons varies.

The local anesthetics vary in toxicity when injected and in rapidity of action when applied locally.



The chemical properties of iodine include its relation to the fatty acids and its value in the treatment of various conditions of interest to the otolaryngologist, such as ozena, it may be used as an antiseptic, as an irritant (stimulating regeneration), in liquid form, as a dusting powder, in treatment of infection by *Trichophyton* and as a substitute for iodoform. Of the dusting powders, thymol iodide and vioform are the best known.

Recently a host of mercuric compounds have been introduced, including mercurochrome, with its dangerous reaction following intravenous administration, metaphen, merbaphen and salyrgan. Mercury in aqueous solution of merthiolate is not precipitated by the serum proteins. It is used in treatment of the nose and the ear in dilutions of 1:2,000 to 1:5,000.

Sulfanilamide belongs to the azo compounds, a nitrogen linkage group. It was chance that led to the discovery that products of this group are of value in the treatment of human streptococcal infections. *Streptococcus viridans* does not respond to drugs of this group. It was soon learned that the more complex azo compounds containing sulfonamide are reduced in the body to the simpler nonazo para-amino form, which can replace the azo sulfonamide forms with even greater clinical value and less collateral ill effect. During administration of sulfanilamide repeated blood counts are necessary, for anemia and granulocytopenia may be induced, the former as an early and the latter as a late effect. The possible development of sulfhemoglobinemia or methemoglobinemia makes it necessary to avoid the simultaneous administration of sulfanilamide and a sulfur compound, even magnesium sulfate. Hemolytic anemia may be foreshadowed by the finding of an increasing reticulocyte count. Erythema, urticaria, morbilliform eruption, photosensitiveness and acidosis have been reported. Hence sodium bicarbonate is frequently given with sulfanilamide to prevent acidosis. The total daily dose should not be more than 75 grains (5 Gm), even for persons weighing over 50 Kg.

## Book Reviews

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The Basis of Tissue Evolution and Pathogenesis By Albert A Gray, M.D., F.R.S.E. Price, 7 s 6 d Glasgow Jackson, Son & Co (Booksellers) Ltd, 1937

One cannot approach this work, published after Dr Gray's death from somewhat incomplete manuscript and notes, without the respect due a brilliant author whose works on "The Ear and Its Diseases," "Otosclerosis" and "The Labyrinth of Animals," have secured international honor. While one may be somewhat skeptical of the ultimate success of his dictum on the treatment of tinnitus and otosclerosis with thyroxin, this scholarly otologist must command attention.

His hypothesis of the origin of tissue is based on the belief that change of environment causes injury and subsequent repair to a given tissue or structure and that a new type of tissue follows this process of repair. In discussing the developmental aspect of the evolution of tissue and pathogenesis, he is of the opinion that *induced variation*, change in tissue brought about by injury from change in environment, rather than spontaneous variation, an evolution due to an accumulation of chance variation or relation, is the true basis of the evolution of tissue. He assumes that pathologic processes are simply deviations from the normal course in the process of repair according to well known biologic laws. Dr Gray illustrates the evolutionary changes and comparative anatomy of the membranous labyrinth by admirable specimens and photographs.

The author concludes that inherited pathologic conditions are of two types: first, those in which the defect is primarily a structural one, present from birth, as in deaf-mutism, and, second, those in which the defect is in the nutritional vasomotor mechanism, appearing some time after the organ has begun to function normally, as illustrated in otosclerosis.

While this work may be impractical for use as a textbook, nevertheless, because of its deep and thoughtful biologic concept it belongs in every library of biologic research.

# Directory of Otolaryngologic Societies \*

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### COLLEGIUM OTO-RHINO-LARYNGOLOGICUM AMICITIÆ SACRUM

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Secretary Prof Dr C E Benjamins, Verlengde Heereweg 143, Groningen, Netherlands

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\* Secretaries of societies are requested to furnish the information necessary to keep this list up to date

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## CANCER OF THE LARYNX

IMMEDIATE AND ULTIMATE RESULTS OF OPERATION IN  
ONE HUNDRED AND TWO CASES

HENRY BOYLAN ORTON, M.D.

NEWARK, N. J.

It is well at times to make an analytic survey of one's work in a special field and to evaluate one's findings. In the contents of this paper, comprising the results of operation in 102 cases of cancer of the larynx, the findings are tabulated under two headings, laryngectomy and laryngofissure.

### ETIOLOGY

In analyzing this series of cases I can find no enlightenment as to the origin of cancer.

TABLE 1—*Sex and Age at Time of Operation*

	Age					
	25 to 30	31 to 40	41 to 50	51 to 60	61 to 70	71 or Over
Laryngectomy						
Male	2	5	22	23	25	9
Female	0	4	2	2	0	0
Laryngofissure						
Male	2	0	0	1	1	1
Female	0	0	2	1	0	0

A history of hereditary involvement was found to exist in only 13 instances. Chronic irritation of some sort or other was noticed in 24 cases, or approximately 25 per cent.

Ninety-one patients were men and 11 women, which gives a ratio of approximately 10 men to every woman.

Cancer is supposed to be rare in persons under 40 years of age, yet in this series there were 11 patients under 40, the youngest being 25 and the oldest 76 at the time of operation.

Among men, involvement occurred in the largest number of cases in the sixth or seventh decade of life. Two patients were Negroes, 1 aged 29 years at the time of operation and the other aged 28. The

Read at the Sixtieth Annual Congress of the American Laryngological Association, Atlantic City, N. J., May 3, 1938.

latter patient had myxosarcoma of the larynx (figs 3 and 4) Among women, involvement in the largest number occurred in the third or the fourth decade of life

Among possible causes, excessive use of the voice was found to have played a part in 30 patients

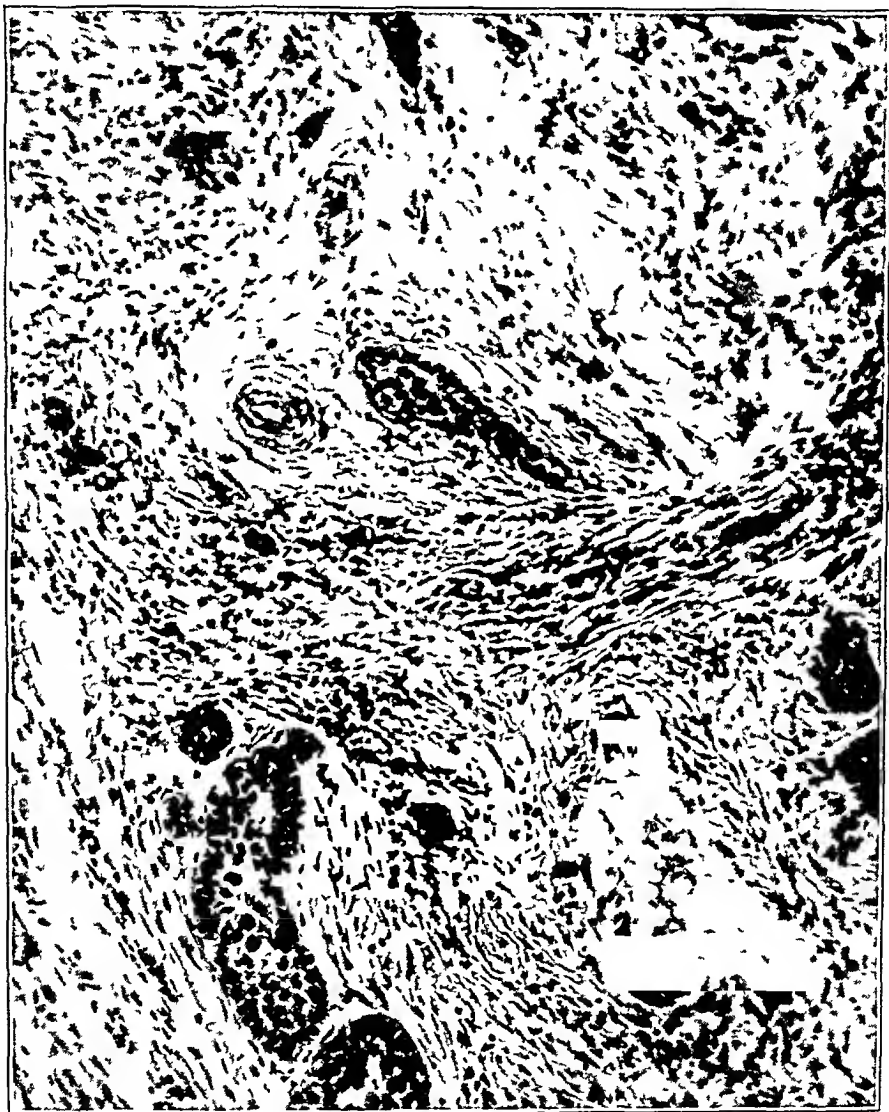


Fig 1—Basal cell carcinoma, an invading malignant growth of all the layers of the surface epithelium, low power

Considering the part that alcohol and tobacco played in causing cancer, I found only 18 patients who had used alcohol moderately or a little more, whereas 38 had used tobacco to excess No great increase of cancer has followed promiscuous smoking of cigarets by either men or women

Syphilis as an etiologic factor in preparing the soil for the growth of cancer was observed in only 3 cases, 1 of which was that of a Negro who had myxosarcoma of the larynx (figs 3 and 4)

Papilloma of the larynx was found in 3 cases, in all of which there had been prolonged observation and frequent removal of papillomas



Fig 2—Same section shown in figure 1, high power

In each instance the papilloma was found to have become malignant in the sixth decade of life. One patient was observed in 1928 to have papilloma of the larynx and was under observation for nine years before the growth took on a malignant character. This patient underwent total laryngectomy at the age of 71 years and is alive and well at

the present time. Another patient, aged 69 years, had been observed for fifteen years by competent laryngologists, who had removed papillomas, he was referred to me last year for operation. The third patient was seen by a competent laryngologist in 1921, because of chronic



Fig. 3—Myxosarcoma of the larynx, low power. The tumor is vascular. It shows mucoid areas of connective tissue and areas of large spindle cells, many with mitotic figures.

hoarseness and multiple papillomas of two years' duration. In this case the papillomas did not become malignant until 1932. It is interesting to note that all these patients used their voices to excess.

*Pachyderma laryngis*, which Jackson<sup>1</sup> and others have stated is a precancerous condition, was found in 2 cases. In 1 instance it was only after repeated biopsy that malignant growth was diagnosed. The patient had a sinus from the larynx to the surface of the skin at the thyroid cartilage, and it was necessary to remove a large area of skin,



Fig 4—Same section shown in figure 3, high power

fascia and muscle surrounding this sinus in performing the laryngectomy. The growth was of squamous cell type. The patient underwent total laryngectomy in 1927 and is alive and well at present, with a good pharyngeal voice (figs 13 and 14).

<sup>1</sup> Jackson, C. *The Larynx and Its Diseases*, Philadelphia, W. B. Saunders Company, 1937, pp 376-496.





Fig 5—Epidermoid carcinoma of the larynx (grade 1), showing irregular papillae covered by thickened stratified squamous epithelium, some dipping into the submucous tissue in the form of nests with central cornification, low power



Fig 6—Same section shown in figure 5, high power

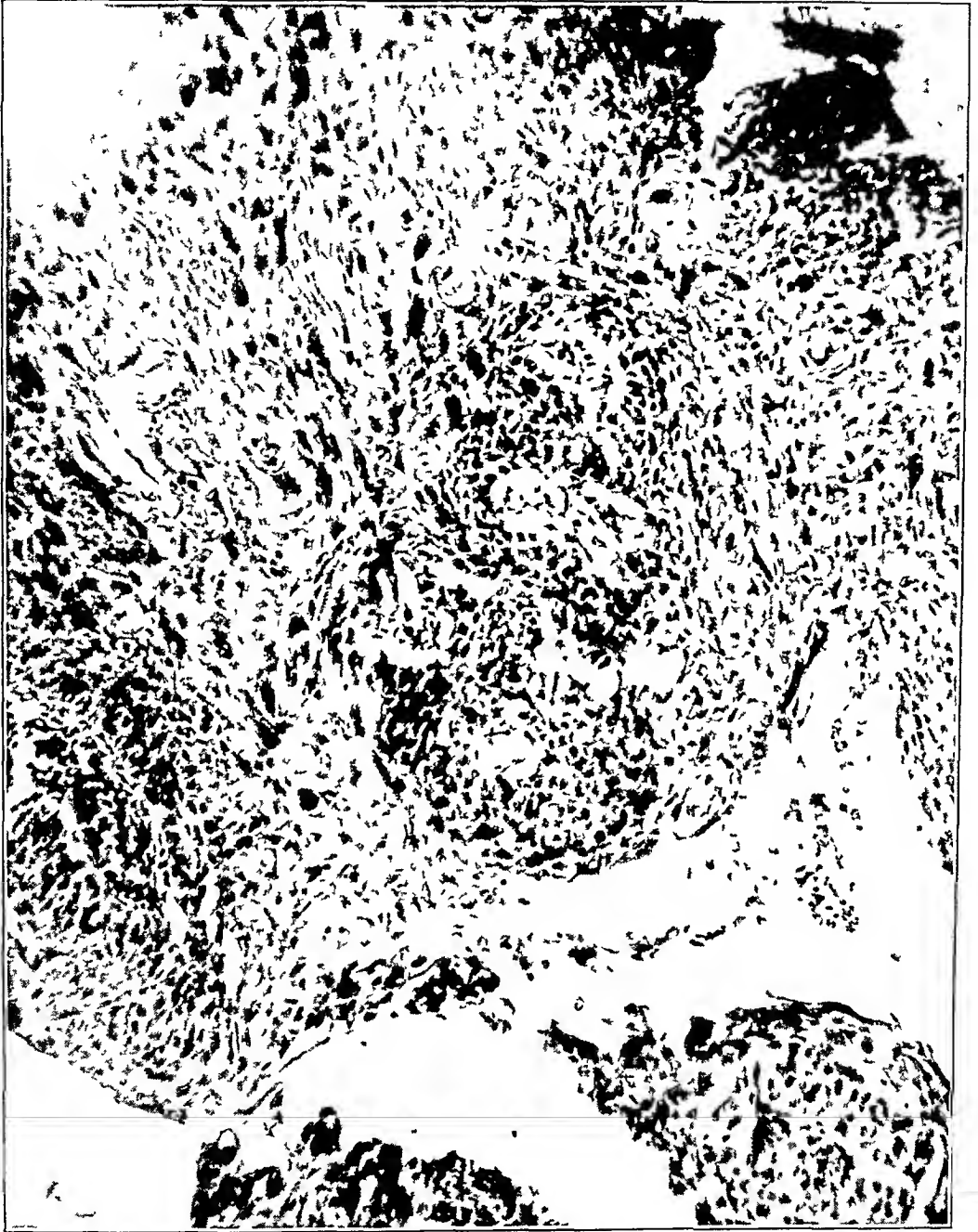


Fig 7—Epithelioma of the larynx (grade 2), low power. The stroma is invaded by groups and strands of carcinomatous cells showing considerable hyperchromatism and a moderate number of mitotic forms. There is a moderate fibrous reaction in the stroma.



Fig 8—Same section shown in figure 7, high power

The possibility that irritating gases play a part in producing cancer was suggested by the case of a man who had been severely gassed during the World War with mustard gas. Whether the development of cancer was a coincidence or was caused by the gas is difficult to determine, as

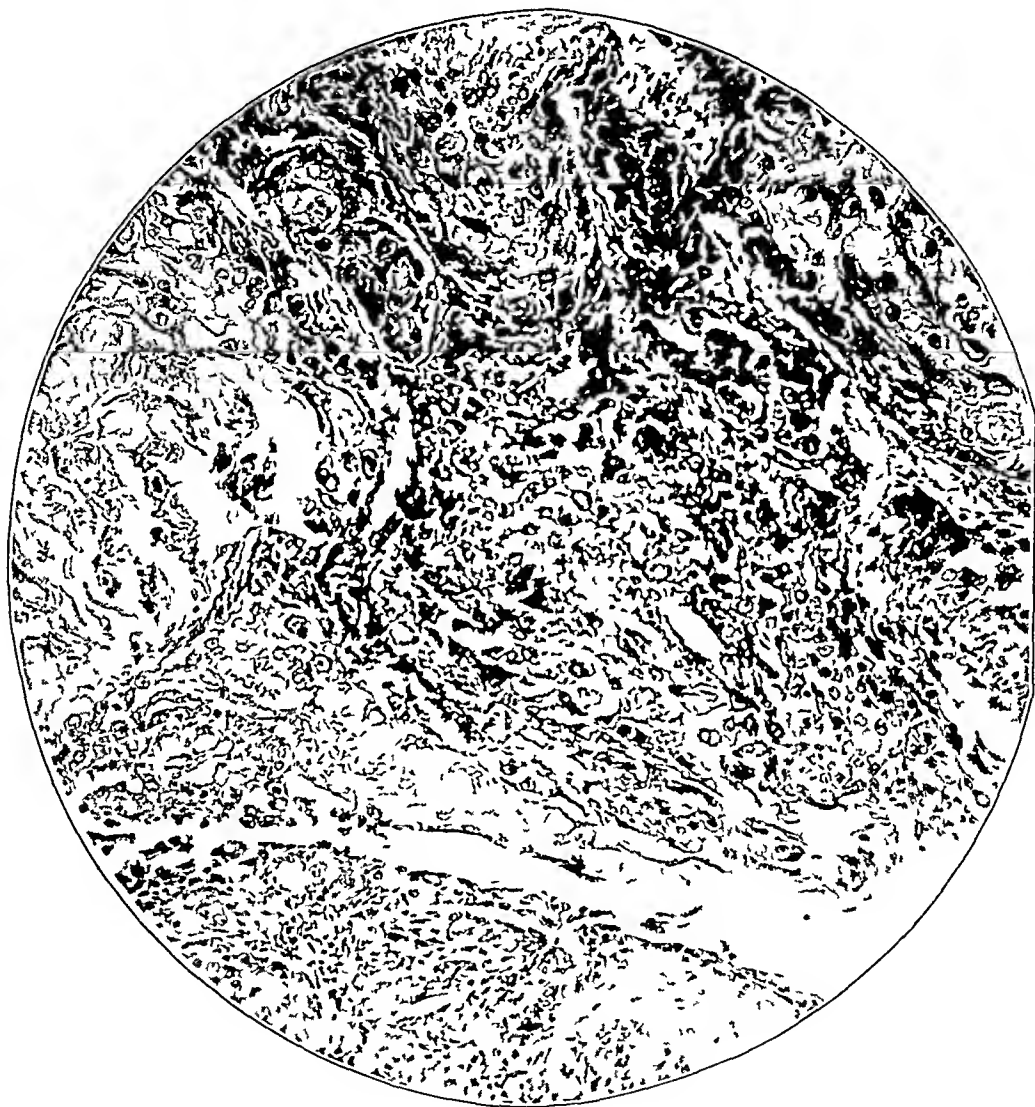


Fig 9—Epidermoid carcinoma of the larynx (grade 3), low power. There is an invasive growth of groups of atypical pavement epithelial cells beneath the surface epithelium. The individual cells are larger than normal and show marked variation in staining. There are numerous epithelial pearls and a few mitotic figures.

I have observed only 1 such instance. This patient underwent laryngectomy in 1925, he is still living and has one of the best pharyngeal voices imaginable (figs 1 and 2).

## CLASSIFICATION

In this series the involvement was intrinsic in 62 cases and was situated below the glottis in 15, in the piriform sinus in 12, in the epiglottis in 2, in the aryepiglottic fold in 7, in the arytenoid cartilage in 2

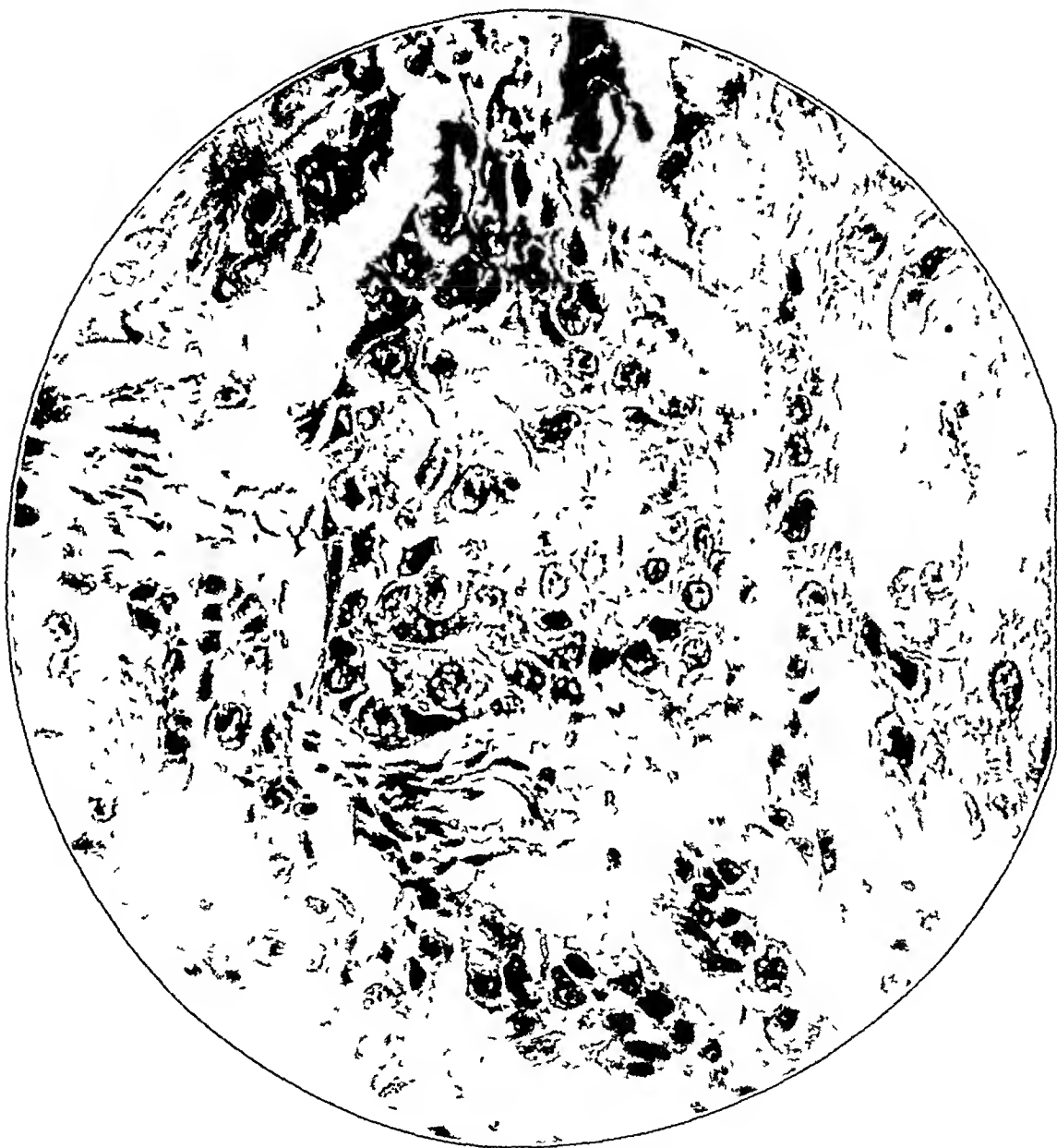


Fig 10 —Same section shown in figure 9, high power

and behind the cricoid cartilage in 2. The involvement in the last five locations is known as extrinsic or epilaryngeal and hypopharyngeal.

*Intrinsic Cancer* —The involvement in 75 per cent of cases (77) was intrinsic, originating in the interior of the larynx.

Intrinsic cancer in the interarytenoid area is rarely seen. Laryngeal cancer involving the ventricular band and the ventricles is rare and is



more dangerous than true chordal cancer. A growth situated in this area causes early glandular involvement. The vocal cord is the favorite site of typical intrinsic laryngeal cancer, which usually spreads along the cord and may become subglottic and spread to the opposite cord or cross at the anterior commissure.

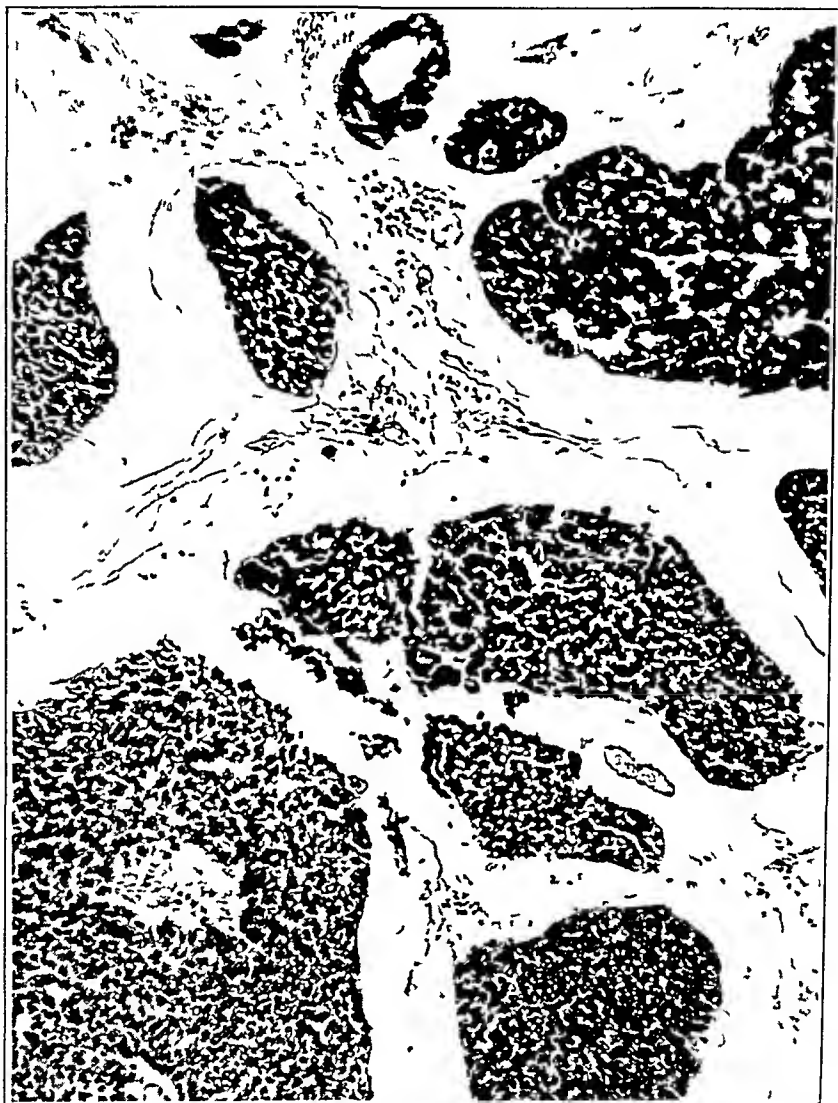


Fig 11—Undifferentiated carcinoma of the larynx (grade 4), low power. The surface epithelium is hypertrophic. In the fibrous stroma there are an extensive invasive growth of groups, cords and masses of undifferentiated epithelial cells which vary considerably in size and some mitosis.

In intrinsic, or chordal, cancer lymphatic drainage is almost negligible, and the results of laryngofissure include from 75 to 85 per cent cures, with practically no operative mortality. In this series, of 8

patients who underwent laryngofissure, 6 patients are alive and well at present, the period since operation ranging from ten to eighteen years

The symptoms of intrinsic cancer depend on the site of growth. A growth affecting the tension, vibration and approximation of the cords will produce hoarseness.

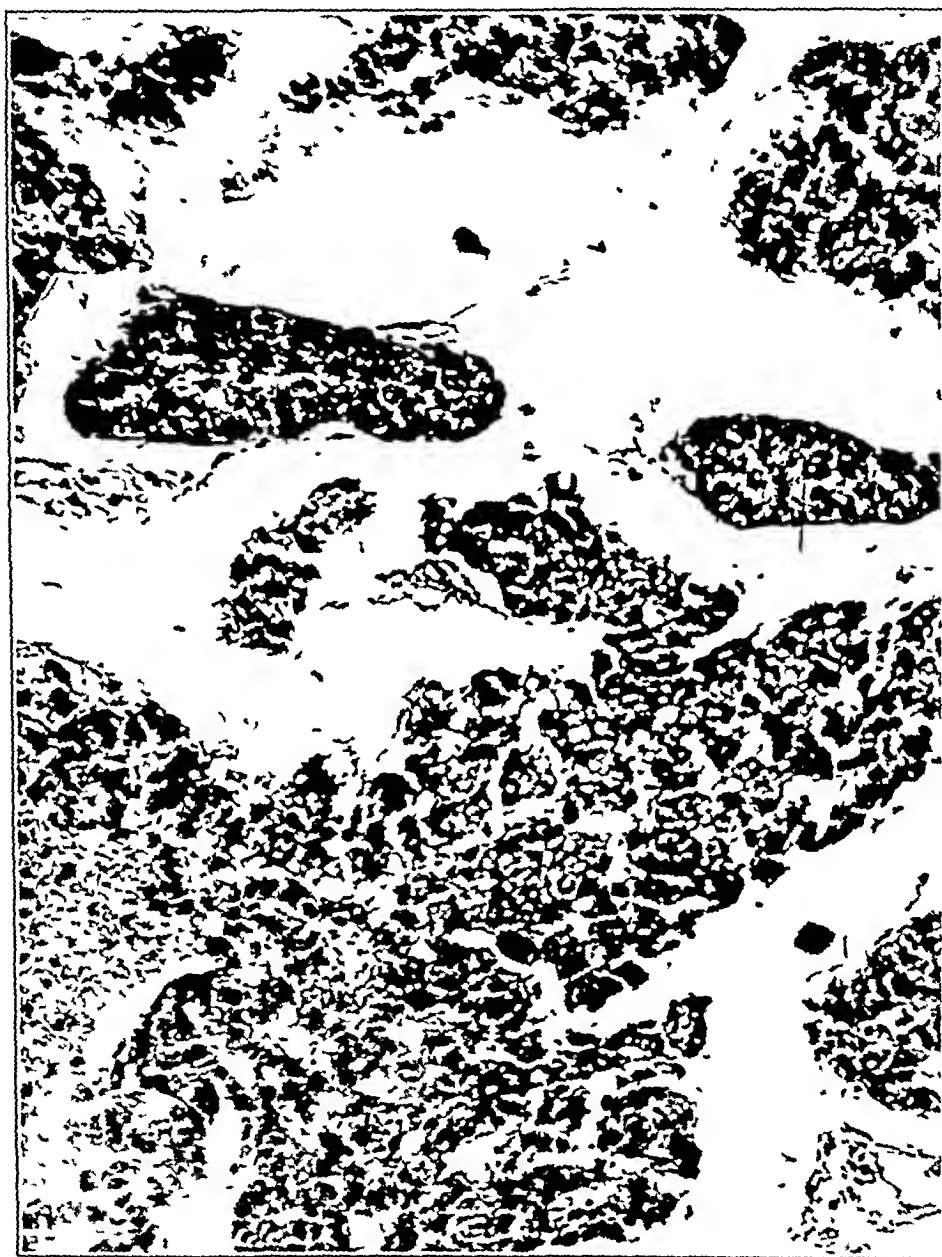


Fig. 12—Same section shown in figure 11, high power

Intrinsic true chordal cancer is located on the surface or the edge of the vocal cord. It may, and often does, extend into the ventricle of the larynx and below the cord into the subglottic area.

**Summary.** Intrinsic cancer is usually benign in the early stages. It grows slowly and if limited to the vocal cord does not metastasize to the



glands The malignant growth is usually squamous cell epithelioma, but occasionally of basal cell type Adenocarcinoma is usually seen in the ventricles Other forms are rare This type must be differentiated from singer's nodule, leukoplakia, innocent tumor, tuberculosis and



Fig 13—Epithelioma of the larynx The patient had pachyderma and a sinus extending to the surface of the skin Laryngectomy was performed in 1927 The patient is still living

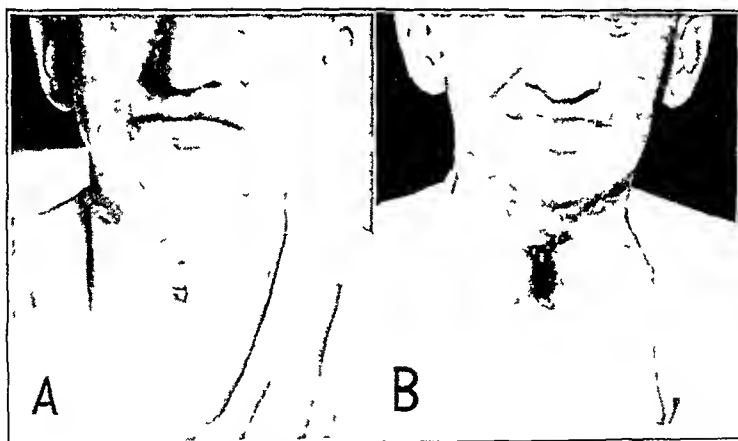


Fig 14—Patient (a) before operation, (b) after operation, in 1927

syphilis The course usually extends over several years, depending on the location and the grade of the tumor Even the most malignant forms usually last over two years

The outlook in this type of cancer is most favorable for cure if diagnosis is made early

*Subglottic Cancer* —Subglottic cancer originates on the inner or the under surface of the vocal cords or the subglottic area, chiefly in the anterior half of this region

The subglottic type, of which there were 15 cases in this series, although well within the larynx, has a large amount of lymphatic drainage, with possible early metastasis along the party wall—into the esophagus or the trachea, for instance For this type I prefer total

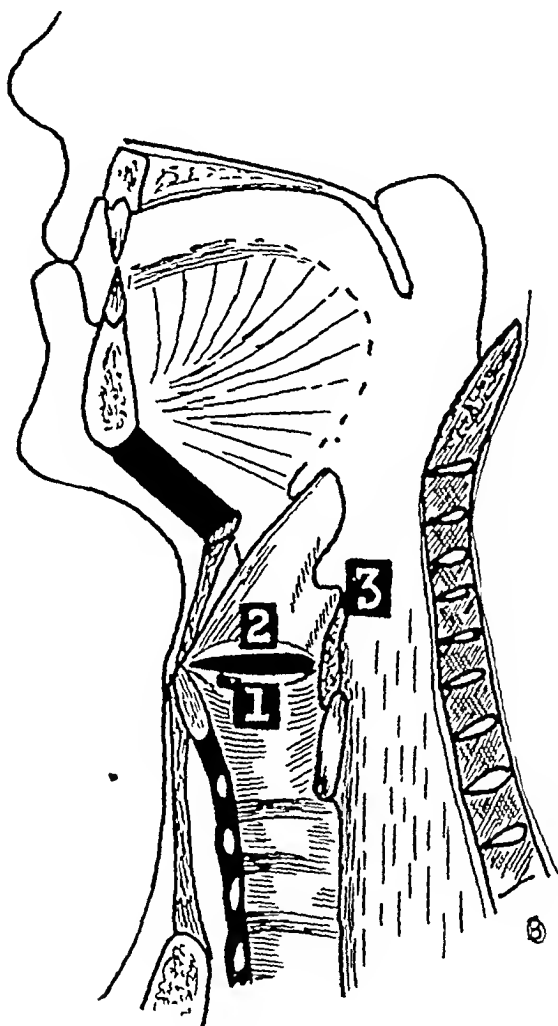


Fig 15—Intrinsic cancer (about 75 per cent of laryngeal cancer is intrinsic) 1 shows the vocal cord, a favorite site for intrinsic cancer, which spreads along the cord and may become subglottic and spread to the opposite cord or across the commissure 2 shows the ventricular band and ventricle These are rarely involved, but their involvement is more dangerous than that of the cord, causing early glandular involvement 3 shows the interarytenoid area, which is rarely affected

The disease is benign in its early stages and grows slowly If limited to the vocal cords it does not metastasize to the glands Cancer is usually squamous cell and occasionally basal cell epithelioma Other forms are rare Adenocarcinoma is seen in the ventricles The condition must be differentiated from singer's nodule, leukoplakia, innocent tumors, tuberculosis and syphilis Its course usually extends over several years, depending on the location and the grade of tumor Even the most malignant forms usually last over two years

laryngectomy to laryngofissure, for in my series (table 2) there were 7 in which the site of the growth at operation was subglottic, and in all these there was a recurrence in the glands of the neck or metastasis to the brain and the lung, and possibly in 1 case to the prostate. It would seem inevitable that if these growths recurred after total laryngectomy they certainly would have done so after laryngofissure. Therefore, I reiterate that I prefer total laryngectomy to laryngofissure for this type of cancer.

TABLE 2—*Deaths from Malignant Growth Elsewhere Than Larynx in Cases in Which Laryngectomy Was Done*

Case No	Age at Operation, Yr	Time of Onset after Operation		Site of Growth at Operation	Age at Death, Yr	Site of Recurrence
		Yr	Mo			
1	50		6	Subglottic	50	Glands
2	63		13	Piriform sinus	64	Glands
8	66		8	Piriform sinus	66	Glands
9	50	1		Epiglottis	51	Tongue
10	60	1	6	Arytenoid cartilage, aryepiglottic fold	62	Glands
13	60	2		Ventricle	62	Esophagus
14	55	2		Postcricoid	57	Esophagus
16	74		9	Piriform sinus	75	Esophagus
20	37	2	6	Trachea (subglottic)	40	Brain and lung
29	63	1		Piriform sinus	64	Neck
37	60		5	Aryepiglottic fold	60	Glands
38	67		8	Piriform sinus	68	Glands
40	69	2	6	Cord, ventricle	72	Glands
42	73	1		Epiglottis, ventricle, piriform sinus	74	Glands
43	48	1		Piriform sinus	49	Glands
51	44	1	5	Piriform sinus	45	Glands
52	45	2		Esophagus	47	Glands
53	65	2	6	Subglottic	68	Tongue and glands
54	73	1	4	Subglottic	74	Lung
56	69	1		Subglottic	70	Brain and lung
70	53		9	Aryepiglottic fold, piriform sinus	54	Tongue
78	40	1	3	Subglottic	41	Glands
87	49		6	Left cord extending to subglottic area	49	Prostate?

The subglottic type originates below the cords, usually in the anterior third, and may involve the anterior commissure, spread to the opposite side and continue to spread upward to the vocal cords or downward to the cricoid cartilage.

Hoarseness is late in cases of this type, although sluggish movement of the cord was noticed. The lesion is usually demonstrable by direct and indirect examination of the larynx.

Dyspnea may be the first symptom, in 1 case it was the only symptom, and for this the patient was referred to me. On laryngeal examination I could plainly see a large growth protruding into the larynx, almost reaching the opposite side.

Dyspnea remains the only symptom until the growth has progressed to affect the mechanism of the larynx and produce hoarseness or to cause stenosis and thereby necessitate tracheotomy

**Summary** Subglottic cancer may spread over a large area before being recognized. Anteriorly it commonly passes through the cricothy-

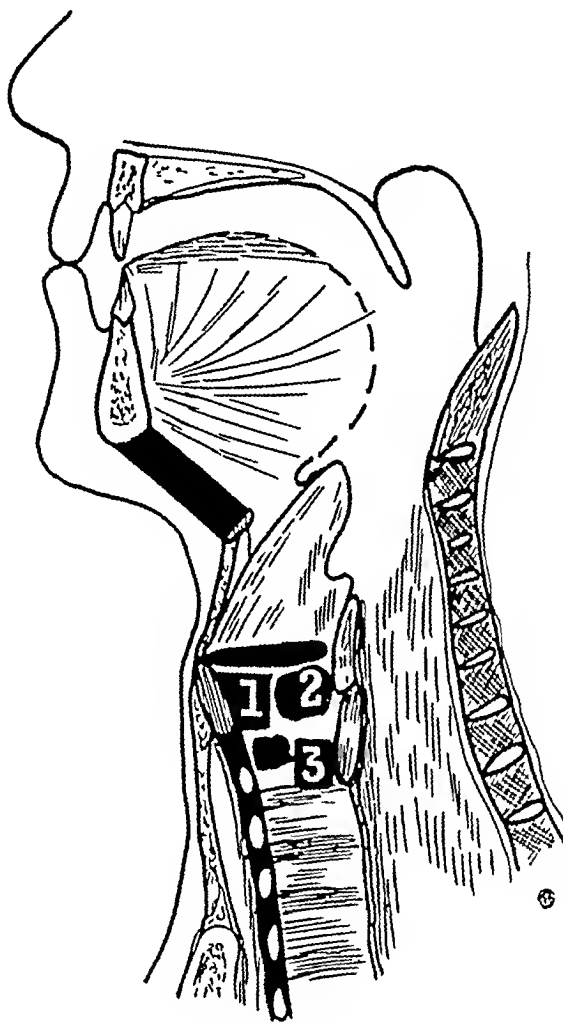


Fig 16—Subglottic cancer originates on the inner or the under surface of the vocal cords or the subglottic area (chiefly in the anterior half of this region) 1 shows intrinsic cancer of the cord becoming subglottic at the anterior commissure, 2 intrinsic cancer of the cord on the inner or the under surface but below the free edge (invasion of the opposite cord is by the subglottic route or across the commissure), 3, true subglottic cancer

The disease may spread over a large area before being recognized. Anteriorly it commonly passes through the cricothyroid membrane and metastasizes to the lymph nodes, often it extends behind the isthmus of the thyroid gland and may extend into the trachea. Posteriorly it may extend to the arytenoid cartilages, invading the pharyngeal mucosa, rapid metastasis to the lymph nodes occurs along the course of the internal jugular vein. Superiorly it may extend into the supraglottic region, invading the base of the epiglottis. Usually the lymph glands escape if the growth is confined to the interior of the larynx or the epiglottis. This is due to poor lymphatic drainage and resistance of cartilaginous walls. The growth is practically always squamous cell epithelioma.

roid membrane and metastasizes to the lymph nodes over this area. It often extends behind the isthmus of the thyroid gland and may extend down into the trachea. Posteriorly it may extend to the arytenoid cartilage involving the pharyngeal mucosa, where rapid metastasis to the lymph nodes along the course of the internal jugular vein takes place. Superiorly it may extend into the supraglottic region, invading the base of the epiglottis.

Usually the lymph glands escape as long as the growth is confined to the interior of the larynx or even to the epiglottis. This is due to poor lymphatic drainage and resistance of the cartilaginous walls.

Subglottic cancer is practically always of squamous cell type.

*Extrinsic cancer*—Extrinsic cancer originates around the glottic opening or on its outer surfaces. This class may be subdivided into the epilaryngeal type, which includes neoplasms arising from the epiglottis, the aryepiglottic folds, the arytenoid cartilages and the pyriform sinus (23 cases in this series), and the hypopharyngeal type, which includes postcricoid cancer (2 neoplasms in this series). Extrinsic cancer is more malignant, and with earlier metastasis to the cervical glands, than intrinsic cancer.

Some pathologists have stated that this type is seldom arrested or cured by surgical procedures. In my series there were 40 cases of extrinsic cancer, with the subglottic type included, there were 23 deaths, or approximately 42 per cent recoveries.

I believe that in the treatment of the epilaryngeal and the hypopharyngeal type of cancer, if early diagnosis is made, good results can be obtained. Too often when the patient presents himself for examination he is beyond any hope of a five year cure. All types of involvement should be diagnosed early, for they are readily seen by direct or indirect examination.

The symptoms depend on the site of the lesion, but hoarseness, a tickling sensation, constant clearing of the throat and a persistent abnormal sensation in this region should arouse the physician to the fact that he is dealing with a potential malignant growth. Later, localized or referred pain, loss of appetite, difficulty in swallowing, increased salivation and enlarged cervical glands usually denote a late, and too often an inoperable, state.

**Summary** Extrinsic cancer is usually of squamous cell type, although it may be papillary or occasionally of basal cell type.

An epithelioma originating on the epiglottis is of relatively low grade malignancy until the growth has spread either to the base of the tongue or to the aryepiglottic fold. In other epilaryngeal situations, however, the lymphatic glands are invaded early and consistently.

Extrinsic malignant growth, therefore, is a serious problem, and as Jackson stated, "To look and see is better than to wait and see"

The glands are affected early, the course is fairly rapid, and unless prompt treatment is instituted a year or a year and a half is the average span of life for the patient

It is true that cancer cannot be cured in all cases, but certainly if this region is examined with painstaking thoroughness much can be accomplished by early diagnosis and radical operation, for cosmetic considerations have no place in the treatment of malignant growths

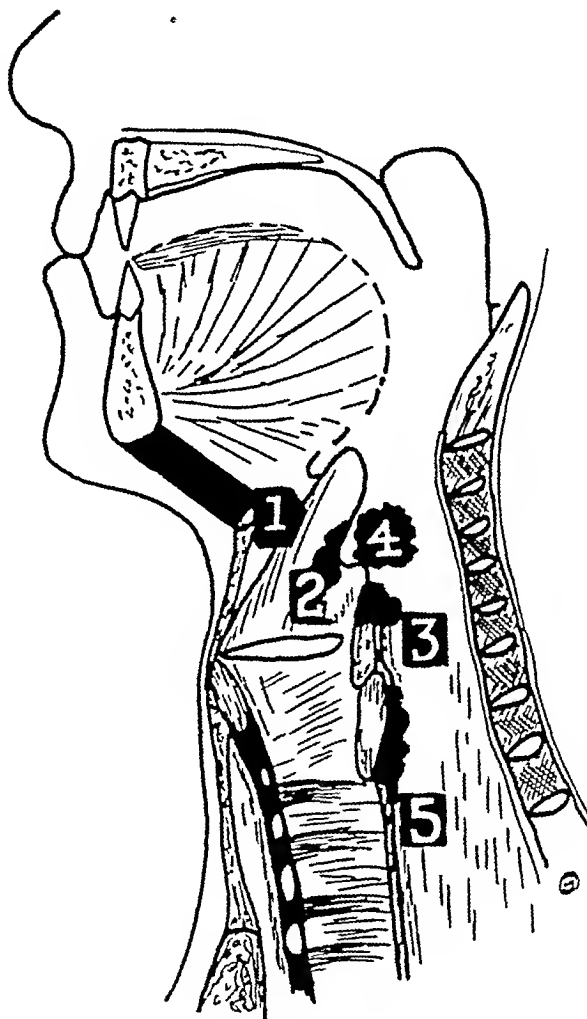


Fig 17—Extrinsic cancer In this group are included neoplasms growing from the epiglottis, the aryepiglottic folds, the arytenoid cartilages, the piriform sinuses and the pharyngeal surface of the cricoid cartilage (postcricoid cancer) 1 shows the margins of the epiglottis, 2, the aryepiglottic folds, 3 the arytenoid cartilages, 4, the piriform sinuses, 5, the pharyngeal surface of the cricoid cartilage

Extrinsic cancer is usually of squamous type, but may be papillary Occasionally the basal cell type occurs Cancer of the epiglottis is of relatively low grade malignancy, unless the growth has spread to the base of tongue or the aryepiglottic fold In other situations lymphatic glands are invaded early "To look and see is better than to wait and see"

## PATHOLOGY

*Histology*—Included in my series were 1 melanosarcoma, 1 myxosarcoma and 4 basal cell and 22 papillary epitheliomas, the most frequent type being the squamous cell carcinoma. The sarcomas originated in the right arytenoid cartilage.

A comparison of Mackenty's<sup>2</sup> table with the findings in my series on the relative frequency of types of cancer of the larynx follows:

Mackenty's Series (Percentage)		This Series (Percentage)
96	Squamous cell carcinoma	75
2	Basal cell carcinoma	3
1	Papillary carcinoma	20
1	Adenocarcinoma	2

Metastatic tumors of the larynx are exceedingly rare, although inoculation metastasis in the respiratory tract has been reported by Hitz and Oesterlin.<sup>3</sup> With this in mind, the surgeon should be careful about disturbing a growth at the time of operation.

Turner<sup>4</sup> described a case in which the first sign of renal cancer was due to a metastasis in one vocal cord. In 1 of my cases operation was performed in 1937 for an intrinsic growth of a papillary type, grade 1, involving the left vocal cord and dipping into the subglottic area. Within nine months the patient died of a large inoperable cancer of the prostate. It is probable that in this case the original tumor might have been in the prostate and metastasized to the larynx.

In my series metastatic glands in the neck and to the tongue were observed. These have usually involved the piriform sinus and the aryepiglottic folds. Metastasis in the esophagus through the party wall occurred in 1 patient. In another patient there was metastasis to the brain and the lung from an adenocarcinoma of the subglottic region two and one-half years after operation. Three patients had metastasis to the lung, 3 to the esophagus, 5 to the tongue and 15 to the glands of the neck. The patients who had metastasis to the lung had metastasis to the brain as well.

In the basal cell type there is apt to be little tendency to recurrence. There were 4 cases of basal cell carcinoma in my series. One case was that of a man 72 years of age at the time of operation, he died

2 Mackenty, J. E. Some Observations on the Cases of Laryngeal Cancer Seen During the Past Year with Microscopical Findings in Three Incipient Cases, *Tr Am Laryng A* **45** 45, 1923.

3 Hitz, H. B., and Oesterlin, E. A Case of Multiple Papillomata of the Larynx with Aerial Metastases to the Lungs, *Am J Path* **8** 333 (May) 1932.

4 Turner, A. L. Metastatic Malignant Tumor of the Larynx, Secondary to Adeno-Carcinoma of the Right Kidney, *J Laryng & Otol* **39** 181 (April) 1924.

of apoplexy twelve years and eleven months after operation. Another patient was operated on at the age of 50 years, and he is still living twelve years and eight months after operation.

In 1 case of adenocarcinoma the lesion was located in the subglottic region.

According to the classification of Broder, the growth in 73 cases was reported by the pathologists as of grade 1 in 27, of grade 2 in 26, of grade 3 in 16 and of grade 4 in 4.

Of the 4 patients with growths of grade 4, 1 who had adenocarcinoma, died two and one-half years after operation of metastasis in the brain and the lung, another, who had intrinsic squamous cell carcinoma, died of apoplexy two and one-half years after operation, without any recurrence, a third, who had squamous cell epithelioma of the right piriform sinus, is still living, according to my records, and a fourth, who had squamous cell epithelioma, died of pneumonia six days after operation.

In other words, among my patients with growths of grade 4, which are supposedly not amenable to surgical procedure, 1 patient who had cancer of the piriform sinus is living six years after operation.

#### SYMPTOMS

The symptoms, of course, vary according to the location of the lesion, whether it is intrinsic, epilaryngeal or hypopharyngeal.

In 89 cases there had been hoarseness of from six weeks to fifteen years' duration. Hoarseness is caused by some interference in the vibration, the approximation or the tension of the vocal cord. This should arouse suspicion of any hoarseness extending over a few weeks in an adult and careful examination of the larynx should be made to ascertain the cause.

Local discomfort that might be characterized as a constant desire to clear the throat and a tickling sensation strong enough to produce cough was noted in 59 cases, more frequently with the epilaryngeal or the hypopharyngeal type of growth, probably because involvement of the superior laryngeal nerve permitted saliva or food to trickle into the larynx and produce coughing.

Pain was next in frequency among symptoms, 45 patients complaining of pain that was referred to the larynx, to the side of the neck or to either ear.

Dyspnea on moderate exertion was complained of by 29 patients. Seventeen patients gave symptoms of stridor and wheeze.

Difficulty in swallowing, or dysphagia, was complained of by 25 patients.

Fetor, due to ulceration, was noted by 9 patients.



Increased salivation was complained of by 15 patients. These were mostly of persons who had the epilaryngeal or the hypopharyngeal type of lesion.

Blood-streaked sputum or saliva was noticed by 5 patients.

An interesting observation was that 39 patients had lost weight. Usually loss of weight is considered a late sign, but in this series about one third of the patients stated at the first examination that they had lost weight.

#### PHYSICAL SIGNS

Alteration of voice was observed in one way or another in 89 patients operated on. It would seem, therefore, that any alteration of voice extending over a considerable time should be regarded seriously and every effort made to determine the cause.



Fig 18—Epithelioma of the larynx, crossing from the left vocal cord below the anterior commissure and invading the opposite cord. Laryngectomy was performed.

The movements of the vocal cords were noted, and the following tabulation made of the results:

Cords Free	Cord Sluggish		Cord Fixed	
	Right	Left	Right	Left
30	25	14	19	14

This shows that the vocal cords do not have to be sluggish in their movement or even fixed for a larynx to harbor cancer. So, if the physician waits for a cord to become sluggish, he has lost valuable time for early diagnosis.

Why the right cord should have been affected more often than the left in this series I am not prepared to state.

Local discomfort in the larynx or the throat for some time was mentioned in 59 cases.

In 27 cases there was dyspnea which ranged from a slight manifestation with the slightest exertion to almost urgent symptoms necessitating preoperative tracheotomy in 10 cases. The severe form naturally occurred in association with subglottic growths. Stridor accompanied



Fig 19—Epithelioma of the larynx involving both cords. Laryngectomy was performed.



Fig 20—Epithelioma of the larynx, spreading from the ventricle to the epiglottis. Laryngectomy was performed.

dyspnea in 17 cases, owing to the narrowing of the glottic chink by the growth.

Choking with meals or when saliva was swallowed was noted in 26 cases. This may have been due to some involvement of the superior laryngeal nerve filaments, which caused slight anesthesia of the larynx,

or to the direction of food or saliva into the larynx by a deformity of the larynx caused by the growth. This symptom was, of course, particularly noticeable in cases of extrinsic involvement.



Fig 21—Epithelioma of the larynx, on the right cord and the ventricle. Laryngectomy was performed.



Fig 22—Myxosarcoma of the larynx, growing from the right arytenoid cartilage and invading the piriform sinus. Laryngectomy was performed.

Enlargement of the cervical glands, either from infection or by metastatic extension, was observed in 15 cases. This was noticed in cases of advanced disease, for with true chordal cancer lymphatic

invasion is rare. The presence in the piriform sinus of mucus which the patient cannot empty on swallowing accompanied extrinsic cancer in 21 cases.

A cushion behind the larynx, preventing perception of the larynx grating on the cervical vertebrae, was noticed in 3 cases. This is usually present with the postcricoid type but is found also in associa-

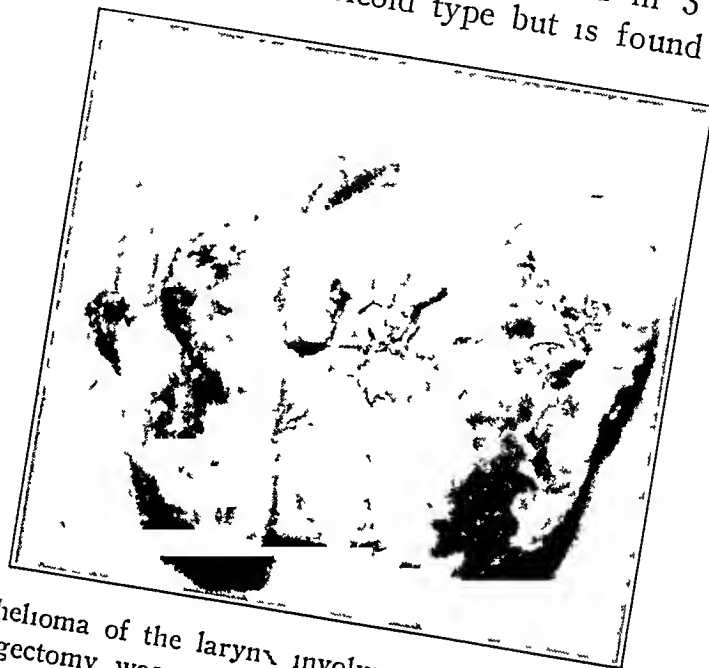


Fig 23—Epithelioma of the larynx involving the right cord and invading the epiglottis. Laryngectomy was performed.

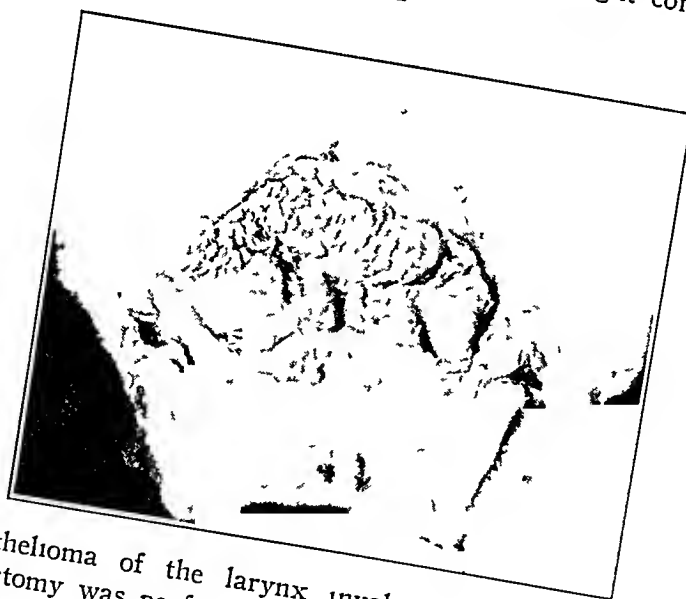


Fig 24—Epithelioma of the larynx involving the epiglottis of a female patient. Laryngectomy was performed.

tion with cancer of the posterior wall of the esophagus, a type not included in this series.

Examination showed 20 patients who appeared to have a projecting papillomatous growth, such a growth affected the voice more than the superficial ulcer type, of which there were 47 cases.

The submucous or embedded type of growth was noticed in 25 cases.



Fig 25—Epithelioma of the larynx involving the ventricle and the epiglottis  
Laryngectomy was performed



Fig 26—Subglottic epithelioma of the larynx (right side), extending upward  
Laryngectomy was performed



Fig 27—True subglottic epithelioma of the larynx (left side) Laryngectomy was performed There was metastasis to the brain and the lung two and one-half years later



Fig 28 Epithelioma of the larynx, involving both cords and the subglottic area Laryngectomy was performed



Fig 29—Epithelioma of the larynx involving both arytenoid cartilages, with infiltration of the cords and the right pyriform sinus (grade 3) Laryngectomy was performed in 1934 The patient is still living



Fig 30—Epithelioma of the larynx involving the right aryepiglottic fold Laryngectomy was performed

## DIAGNOSIS

Diagnosis depends on careful study of the history and of the physical signs already alluded to, proper laryngologic examination and biopsy with histologic study



Fig 31—Epithelioma of the larynx involving the right piriform sinus, showing ulcerating area Laryngectomy was performed

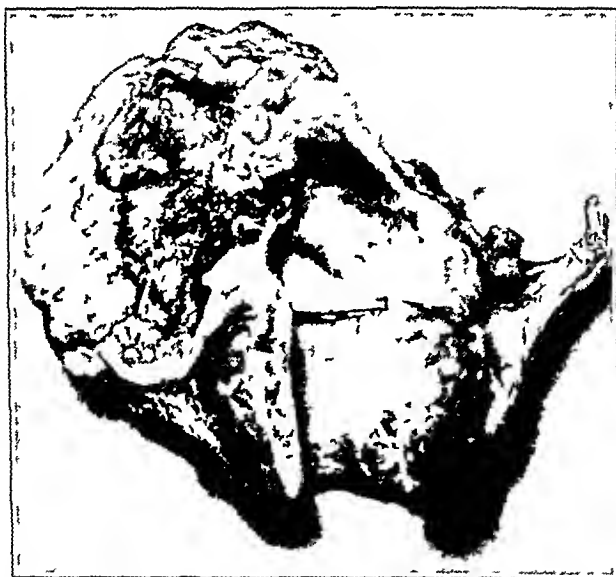


Fig 32—Epithelioma of the larynx involving the left aryepiglottic fold to the base of the tongue Laryngopharyngectomy was performed There has been no recurrence after two and one-half years

Eight of 102 patients presented themselves for examination early enough for laryngofissure to be feasible, according to my interpretation of true chordal cancer In the other 94 patients the disease had



progressed to such an extent that in my judgment total laryngectomy was in order

Syphilis and tuberculosis are ruled out by proper tests and roentgen studies of the chest. It must be remembered, however, that



Fig 33—Epithelioma of the larynx involving the epiglottis mostly on the right side and the subglottic area on the same side. Laryngectomy was performed



Fig 34—Epithelioma of the larynx (postcricoid or hypopharyngeal). Laryngopharyngectomy was performed. There was a recurrence two years later

syphilis, tuberculosis and cancer may all be present in the same larynx. Tuberculosis and cancer occurred in 1 of my cases (fig 35)



Fig 35—Epithelioma of the larynx involving the right cord, with tuberculosis of the epiglottis



Fig 36—Postmortem specimen in a case in which the differential diagnosis showed acute edema of the larynx

Biopsy specimens were taken from all patients, and histologic examination ruled out innocent tumors, such as laryngeal varix and fibroma.

A patient with cancer talks with a strong rough voice, usually without pain. The opposite is true of patients with tuberculosis.

Hoarseness varies from an intermittent to a continuous type, usually being better in the morning, after the patient has rested.



Fig. 37.—Postmortem specimen in a case of syphilis of the larynx. The differential diagnosis showed contractions due to ulcerations.

Cough ranging from a slight tickling sensation to a constant irritating type is present.

Difficulty in swallowing with or without food, increasing dyspnea, which may be followed by stridor and wheeze, increased salivation, and the presence in the piriform sinus of mucus which cannot be emptied spell trouble, especially when associated with other signs, such as blood-tinged saliva or slight hemorrhage and loss of weight. Thirty-nine patients stated that they had lost weight.

Palpation of the neck and the finding of unilateral or bilateral involvement of the glands, plus laryngologic examination with proper illumination to ascertain the type of growth, are important, whether it is projecting into the lumen of the larynx or a superficial ulcer, an embedded tumor or a combination of these is usually unilateral, although if seen late may be bilateral.

The mobility of the cords—whether their action is free or sluggish or whether they are fixed—should be correlated with the physical signs



Fig. 38—Postmortem specimen of cancer involving the right pyriform sinus, the epiglottis and the base of the tongue.

already mentioned, which depend on the site of the lesion. Last but not least, a direct laryngoscopy should be done and a small piece of tissue removed with a biting forceps. Histologic examination of the specimen removed will indicate the type and grade of malignancy and whether the growth is radioresistant or radiosensitive.

#### PROGNOSIS

Prognosis varies according to the location of the lesion.

In cases of true chondroid cancer operation may produce 80 or 85 per cent cures.

In cases of subglottic intrinsic cancer the chance of cure lessens as the distance of the growth from the edge of the vocal cords increases. In other words, the cords are like the timber line. Nothing takes root above, but in the valley vegetation is abundant. So the farther away from the cords, the greater are the growth and lymphatic extension.

The severity of the prognosis increases successively in each of the following types: the epiglaryngeal type of cancer, which comprises cancer of the epiglottis, of the aryepiglottic fold, of the arytenoid cartilage and of the piriform sinus, and the hypopharyngeal or post-cricoid type.

#### TREATMENT

In this series of cases true chordal cancer was treated by laryngofissure (table 3).

TABLE 3—*Operative Results in Eight Cases of Laryngofissure*

Case No.	Age at Operation, Years	Sex	Result
1	48	Female	Alive and well 18 yr 5 mo after operation
2	41	Female	Alive and well 12 yr 8 mo after operation
3	39	Male	Alive and well 10 yr 10 mo after operation
4	34	Female	Alive and well 10 yr 1 mo after operation
5	79	Male	Died 6 days after operation (of angina pectoris)
6	61	Male	Growth recurred in larynx 10 months after operation, patient died at age of 62
7	26	Male	Alive and well 8 mo after operation
8	26	Male	Alive and well 6 mo after operation

The subglottic type and all extrinsic types were treated by total laryngectomy,<sup>4a</sup> laryngopharyngectomy and, in 1 instance, lateral transthyroid pharyngotomy.<sup>4b</sup>

*Preoperative Preparation*—The patient is admitted to the hospital four or five days before operation. During the intervening period a determination of metabolic rate, chemical analysis of the blood and roentgenograms are made. An internist makes a cardiovascular examination and gives his opinion of the operative risk.

Careful attention is given to the cleansing of the mouth with a toothbrush and a 25 per cent alcohol mouthwash before and after meals. The colon is cleansed by administration of a laxative and of a high enema of 1 drachm (3.9 Gm.) of pure sodium bicarbonate to 2 quarts (1.89 liter) of water, this is followed by colonic irrigations.

4a Orton, H. B. Laryngectomy, Single Stage—Operative Results, *Tr. Am. Laryng. Rhin. & Otol. Soc.* **38** 81, 1932.

4b Trotter, W. Some Principles in the Surgery of the Pharynx, *Lancet* **2** 833 (Oct 17) 1931. Orton, H. B. Lateral Transthyroid Pharyngotomy. Trotter's Operation for Malignant Conditions of the Laryngopharynx. *Arch. Otolaryng.* **12** 320 (Sept.) 1930.

with a large colon tube and 2 or 3 gallons (from 7.6 to 11.4 liters) of saline solution. Every other day a modified irrigation with 1 gallon (3.8 liters) of saline solution is given, and sodium bicarbonate, 3 drachms (11.6 Gm.) in twenty-four hours, is given by mouth between meals for three days preceding operation.

The diet during this period is nutritious but of low protein content, including no eggs, milk or beef. Well cooked cereals with cream, chicken, thick soups, spaghetti, rice, bread and butter, vegetables, fruits and juices are given. For twelve hours before operation no food is given, water is permitted up to three hours before operation. Three hours before operation the neck is shaved well back, as well as the upper part of the chest. Soft soap on cotton (with no brush), sterile water and then alcohol are used. No dressing is employed. The bladder is emptied at the last moment.

*Laryngectomy*—Anesthesia induced with avertin in amylene hydrate and ether is used. A T incision is made, the transverse line being on a level with the hyoid bone and extending from one anterior border of the sternocleidomastoid muscle to the other and the vertical line from the center of the hyoid bone to the suprasternal notch. These flaps are dissected backward far enough to afford good exposure, the requisite procedure in attacking all forms of cancer. All superficial veins are ligated. Then the superficial cervical fascia is divided in the median line. The sternohyoid muscles are separated on both sides, severed from the hyoid bone and reflected laterally. The thyrohyoid and the sternothyroid muscle are then removed. At this point, if the isthmus of the thyroid gland is high, it is divided and ligated and the gland separated from the trachea at its upper margin. In this procedure the cricothyroid arteries are ligated. The artery and vein of the superior laryngeal nerve are exposed and ligated with three ligatures, the vessels being divided between two of them so that the upper ligated end has two ligatures. The larynx is then rotated to bring the posterior border of the thyroid cartilage into view. The constrictor muscles are cut along this border. The same procedure is carried out on the opposite side.

The larynx is now free except for the posterior wall, where it is in relation with the esophagus.

The trachea is severed just below the cricoid cartilage. A small gauze pack is inserted into the larynx to prevent leakage from the mouth into the wound. The tissue above the severed trachea is packed with gauze to prevent blood from entering the trachea. An anchor suture is placed in the trachea for future use. The Tucker anesthesia tube is placed in the trachea and surrounded firmly with gauze packing, and the anesthesia is then continued through the trachea. The larynx is dissected from the pharynx. The pharynx is then opened, and a large pack is inserted into the pharynx. This is withdrawn through

the mouth after operation. The larynx is removed, the pharyngeal opening is closed with interrupted thread sutures, and just before the last suture is tied the packing is removed from the mouth. A nasal feeding tube is passed through one nostril and guided down the esophagus. The last suture is then tied. Interrupted catgut sutures are placed in the esophagus. The third layer of sutures is in the constrictor muscle of the pharynx. Attention is then directed to the hyoid bone, which is removed by careful dissection to allow a better closure. The trachea is anchored to the skin by means of silkworm gut suture to relieve tension. Black silk thread is used to suture the skin to the trachea. The sternohyoid muscle is then brought to the area behind the trachea, making four lines of sutures over the pharyngeal openings. Counterdrains are placed on both sides of the neck and across the neck at the top of the T. The skin is brought together with skin clips.

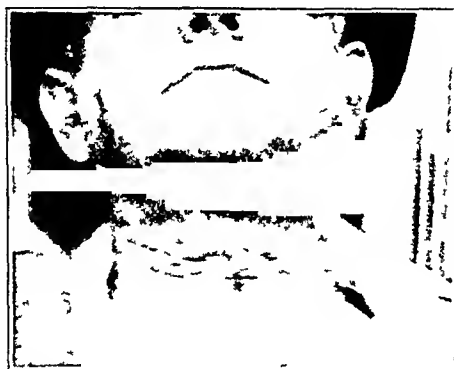


Fig. 39—Patient on whom laryngofissure was performed June 24, 1927. The only one in my series of patients undergoing laryngofissure who stated that the growth was hereditary. The patient is alive and well at present, eleven years after operation.

The laryngectomy tube is made to fit tightly in the trachea by the winding of narrow tape around the upper end. Dressings are applied, the patient is removed to bed, and the postoperative treatment is instituted.

**Postoperative Treatment.** The gown is changed before the patient leaves the operating room. The bed is warmed and the hot water bag removed before the patient is put into it, and 500 cc. of a 5 per cent solution of dextrose is administered intravenously. A bed suction pump is installed alongside the patient's bed and kept there. A necessary laryngectomy tray with a duplicate tube is always in readiness. The patient's position is changed frequently. Saliva is removed from the mouth by suction and a 25 per cent alcohol mouth wash used. Outer dressings are changed as often as they become soiled. No morphine

TABLE 4—*Death from Any Cause Within Three Weeks After Laryngectomy*

Case No	Age at Operation, Years	Period Following Operation, Days	Cause of Death
3	70	2	Diabetes, chronic nephritis
6	54	25	Abscess, gangrene of lung
11	75	5	Pneumonia
49	64	6	Pneumonia, abscess of lung
77	28	21	Meningitis, septic pneumonia, Wassermann reaction 4 plus

TABLE 5—*Death from Other Causes in Cases of Laryngectomy*

Case No	Age at Operation, Years	Age at Death, Years	Period After Operation		Cause of Death
			Yr	Mo	
4	72	85	12	11	Apoplexy
17	48	53	5		Injury by train
23	63	65	2	6	Apoplexy
26	38	40	2	3	Sudden death by accident
33	76	82	6		Coronary thrombosis
41	60	60		2	Tuberculosis
45	62	66	4	2	Apoplexy
48	49	49		4	Hemorrhage
86	71	71		1	Gastric ulcer, perforation

TABLE 6—*Patients Alive and Well After Laryngectomy*

Case No	Age at Time of Operation, Years	Sex	Period Since Operation		Case No	Age at Time of Operation, Years	Sex	Period Since Operation	
			Yr	Mo				Yr	Mo
5	50	Male	12	8	62	63	Male	3	6
7	55		12	5	63	56	Female	3	6
12	50		10	7	64	45	Male	3	5
13	48		10		65	37	Female	3	5
18	66		9	6	66	52	Male	3	5
19	49		9	7	67	48		3	1
21	45		8	3	68	52		2	8
22	70		8	5	69	56	Female	2	8
24	41		8	3	71	61	Male	2	6
25	54		8	3	72	63		2	4
27	54		7	11	73	68		2	5
28	67		7	10	74	49	Female	2	3
30	60		6	8	75	53	Male	2	1
31	49		7	5	76	39		2	1
32	52		8		79	42	Female	1	7
34	60		6	6	80	67	Male	1	6
35	46		6	4	81	56		1	5
36	63		6	3	82	51		1	4
39	75		5	9	83	39		1	4
44	55		5	3	84	61		1	4
46	49		5		85	46		1	
47	40		5		88	62			9
50	47		4	10	89	71			5
55	60		4	3	90	69			
57	52		4	2	91	40	Female		4
58	40		4		92	61	Male		4
59	58		3	11	93	63			1
60	46		3	10	94	55		2	5
61	29		3	9					



is given. The patient should be out of bed the day after the operation. The diet should be of high caloric value. Special nursing is required.

**Complications.** The immediate complications following operation are listed in table 4. Three of the patients to die in this period were among the first 11 operated on.

Among later complications, hiccup became distressing in 3 cases. Medication did not seem to have any effect on the spasm. The only beneficial result was obtained by partial withdrawal of the feeding tube from the esophagus and its reinsection to half the former distance. In this series there was little postoperative vomiting, but in these 3 cases vomiting started early, suggesting the possibility that the lower end of the feeding tube became curved on itself in the esophagus.

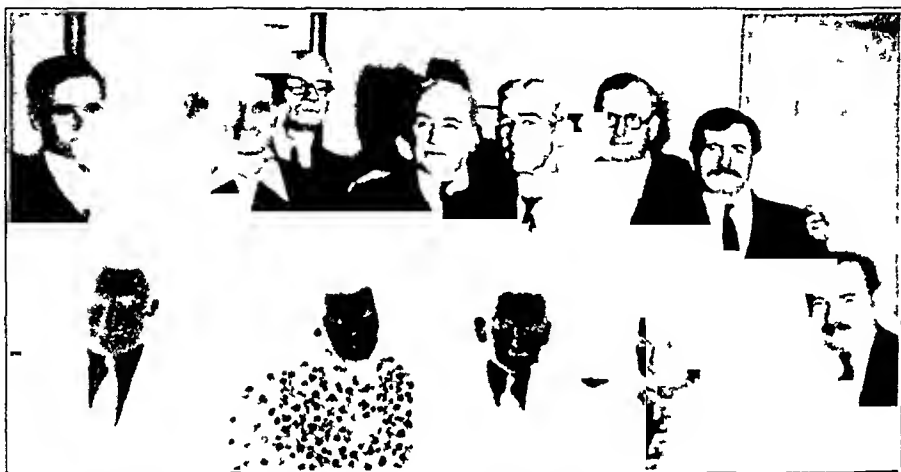


Fig. 40—Recent photograph of laryngectomized patients attending a speech class.

Two patients had severe hemorrhage. One, a man, was sitting in a chair playing cards with his nurse three weeks after operation when he suddenly had a severe hemorrhage. The other patient, a woman with hypertension, had a severe hemorrhage two weeks after operation. In both instances bleeding was from the superior thyroid artery. The value of specially trained nurses for patients who have undergone laryngectomy is hereby emphasized, for such nurses were able to control the hemorrhage by pressure until the wound was opened and the bleeding points ligated. Both of the patients are alive and well at the present time.

Erysipelas developed in 1 patient two weeks after operation. He made an uneventful recovery but died five months later of a recurrence of the tumor.

**Speech After Laryngectomy and Its Psychologic Aspects.** I am convinced that all patients can acquire a pharyngeal voice if they

wish to Some of my patients begin with the Mackenty<sup>5</sup> artificial larynx for practice in forming the words, but later all discard the instrument

To assist these patients in the rehabilitation of speech, my office nurse, Miss M A Lumbreyer, and Mrs H Weiss, my secretary, with my sanction, instituted a class in speech The speed with which these patients acquired the pharyngeal voice was indeed a revelation Their close association in the class was a great incentive for the members to try to surpass each other (Figure 40 is a recent picture of some of the class patients) The attendance at this class averages between 15 and 20 patients at each lesson

Specially trained nurses are in attendance for operations and for after-care It is essential in cases of laryngectomy that the attending nurse have a cheerful disposition, for this is the most important factor in tiding the patient over the usual period of depression which comes on about the third day The number of visitors is limited to members of the immediate family

Getting the patient out of bed the day after operation is most valuable psychologically, in that it raises the morale materially After such an operation the patient naturally assumes that he will be bedridden for some time, and he is much surprised to be permitted out of bed for fifteen minutes of the next morning and afternoon and for increasing periods daily thereafter Despite their handicap, not 1 patient has taken the attitude that life is not worth living

Consider for a moment the case of an Italian patient who, though he could speak English, could neither read nor write it When I removed his larynx, this man certainly had every reason to be despondent, but, strange as it may seem, he was able to talk before he left the hospital and at the present time has one of the best possible pharyngeal voice This is one example among many that could be cited

With all this in mind, I cannot agree with those who state that a laryngectomized patient finds life scarcely worth living

*Laryngofissure*—Laryngofissure was done in cases in which the growth was limited to one cord, freely movable and of short duration In most of these cases the growth was so small that it was almost entirely removed for biopsy The results were gratifying (table 3)

It hardly seems necessary to describe laryngofissure in detail before this association, as the members are all familiar with the technic described by Thomson<sup>6</sup> and by Jackson,<sup>1</sup> which has been carried out in this series

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<sup>5</sup> Mackenty, J E Malignant Disease of the Larynx Rare Type, Premalignant Conditions and Conditions Simulating Malignancy, Arch Otolaryng 20:297 (Sept) 1934

<sup>6</sup> Thomson, St C Cancer of the Larynx, New York, The Macmillan Company, 1930

Figure 39 shows a minister who underwent laryngofissure eleven years ago, he carried on his activities until his retirement last year. I saw the patient two weeks ago, he is looking remarkably well and there has been no recurrence.

*Irradiation*—Sixteen patients had postoperative irradiation with varying success. In some cases it was done as a precautionary measure. In others it followed resection of glands if they were low in the neck. Preoperative irradiation was given to 2 patients.

#### TABLE 7—Recapitulation

Laryngectomy (including lateral transthyroid pharyngotomy in 1 case)—94 patients

57 alive and well  
 7 died within three weeks of operation  
 23 had recurrence  
 9 died from other causes  
 57 are alive and well  
 9 died from other causes  
 —  
 66 successful  
 5 alive and well under 1 year  
 30 alive and well 1 to 5 years  
 18 alive and well 5 to 10 years  
 1 alive and well 10 years and over

Laryngofissure—8 patients

6 alive and well  
 1 died within three weeks of operation of coronary disease  
 1 had recurrence  
 2 alive and well under 1 year  
 1 alive and well from 10 to 18 years

Combined results—102 patients

63 alive and well  
 6 died within three weeks of operation  
 24 had recurrence  
 9 died from other causes  
 7 alive and well under 1 year  
 30 alive and well 1 to 5 years  
 18 alive and well 5 to 10 years  
 8 alive and well 10 to 18 years  
 —  
 63

63 alive and well + 9 (died from other causes) = 72 successful

#### CONCLUSIONS

Early recognition and diagnosis of cancer of the larynx makes possible cure by surgical measures—laryngofissure, laryngectomy or lateral transthyroid pharyngotomy.

Since there is recurrence in 50 per cent of cases of subglottic cancer, I believe total laryngectomy is preferable to laryngofissure in its treatment.

I cannot agree with those who say that laryngectomy is a mutilating operation.

In my experience laryngectomized patients have not been despondent, they have been a happy lot, getting a great deal out of life.

# OBJECTIVE TINNITUS AURIUM

ERNEST A BREDLAU, M D

CHICAGO

The origin of tinnitus is not definitely known. That it must arise from abnormalities in the auditory system, either locally or in the nerve mechanism, is obvious. Two types of tinnitus are differentiated—the subjective type, which is heard only by the patient, and the objective type, which can be heard also by an observer.

There will be considered here only the objective type, which may be either vascular or muscular in origin. The vascular type occurs most commonly in the adult. The muscular type is less common and is found particularly in children. The vascular type of objective tinnitus is heard with the aid of a stethoscope or an auscultation tube, while the muscular variety can often be heard by an observer at a distance of from 1 to 2 feet (30 to 60 cm) from the patient.

## REVIEW OF LITERATURE

Friedmann<sup>1</sup> cited Politzer as reporting a case<sup>11</sup> in which he had observed rhythmic movements of the soft palate, associated with separation of the anterior and posterior walls of the eustachian tube, synchronously with an audible clicking sound. Politzer also observed a synchronously associated movement of the soft palate. Friedmann<sup>1</sup> ascribed the noises he heard in a 9 year old girl, in the absence of demonstrable disease, to contractions of the muscles about the eustachian tube. He drew this inference from observing a rhythmic movement of the soft palate. The condition was considered by him to have a nervous or a hysterical genesis. He quoted Kaiser to the effect that the noise is a sound produced by contractions of the tensor tympani muscle.

Jones and Knudson<sup>2</sup> also described a case of objective tinnitus in which they observed a spasmodic contraction of the palatal muscles. They explained the clicking sound by the forcible opening of the

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Submitted as a candidate's thesis to the Chicago Laryngological and Otological Society, in April 1934.

From the Department of Laryngology, Rhinology and Otolaryngology, the University of Illinois College of Medicine.

1 Friedmann, C. On Objective Tinnitus, *Ztschr f Ohrenh* 46 373 1904

2 Jones, K H, and Knudson, V S. Certain Aspects of Tinnitus, Particularly the Treatment, *Laryngoscope* 38 597, 1928

eustachian tube with each contraction, referring to a condition of this type as pseudotinnitus because the noise is merely conducted to the ear by way of connecting or contiguous structures

Kafka,<sup>3</sup> in an exhaustive article on tinnitus, insisted that objective sounds may be produced by violent contraction of the stapedius or of the tensor tympani muscle. He stated that this condition is associated with neurotic and neurasthenic persons. In other cases he ascribed the sounds to aberrations in the circulation resulting from aneurysms of the carotid artery. These sounds are of low medium pitch, are synchronous with the heart beat and may be stopped by compression of the carotid arteries.

Brieger<sup>4</sup> reported a case in which he stated that the noises were produced by simultaneous irritation of the tensor tympani and the tensor veli palatini muscle. Division of the tensor tympani muscle in his case arrested the noise for a short time, but subsequently it returned, louder and more distinct than before, and was associated with spasm of the soft palate. Brieger stated that contraction of the tensor tympani muscle alone is too delicate a movement to produce so intense a noise. Weil<sup>5</sup> made the observation that in cases of severe anemia objective tinnitus may occur as a "venous hum," originating in the vessels of the neck and transmitted to the ear. Yates<sup>6</sup> reported a case of the vascular type of tinnitus in which the noise could be stopped by pressing lightly on the soft tissues behind the angle of the jaw or by turning the patient's head toward the affected side.

Iglauer<sup>7</sup> reported 4 cases of objective tinnitus in all of which the condition arose from a vascular cause. He expressed the belief that the sounds originated in the region of the bulb of the jugular vein. Tinnitus disappeared in the majority of cases when the head was turned in certain directions. He concluded that rotation of the head has some effect on the circulation in the jugular vein and its bulb, as the carotid artery is too rigid to be affected by turning. In his opinion, the carotid artery has no influence on this type of tinnitus. In 2 of his cases tinnitus was temporary. In case 2 here reported the tinnitus began in the early months of pregnancy and ceased spontaneously about the seventh month,

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3 Kafka, M. M. Tinnitus Aurium. Etiology, Differential Diagnosis, Treatment and Review of Twenty-Five Cases, *Laryngoscope* **44** 515, 1934

4 Brieger, O. Klinische Beiträge zur Ohrenheilkunde, Wiesbaden, J. F. Bergmann, 1896, p. 140

5 Weil, A. A Case of Objective Tinnitus Aurium, *Laryngoscope* **14** 202, 1904

6 Yates, D. G. Case of Objective Tinnitus Aurium, *Ann. Otol., Rhin. & Laryng.* **19** 734, 1910

7 Iglauer, S. Objective Tinnitus Aurium, *Arch. Otolaryng.* **18** 145 (Aug.) 1933

in case 3 it was attributed to endocrine and vasomotor disturbance arising during the menopause, and relief was obtained by the use of whisky

Bárány<sup>8</sup> divided tinnitus into subjective, objective and combined types as a condition in which an objective sound is present but is too weak to be heard by an observer. He concluded that examples of this type of tinnitus result from abnormal pulsations in the small arteries about the facial ridge or from voluntary contractions of the stapedius muscles, produced by pulling back the lower jaw after opening the mouth. Sudden turning of the head to one side may produce a similar noise. Passow,<sup>9</sup> Hamburger<sup>10</sup> and Iglauer<sup>7</sup> reported cases of extracranial aneurysm involving the temporal and occipital arteries. In all cases cessation of the tinnitus was obtained by destroying the vessels.

In the following cases of the objective type of tinnitus the several variations are illustrated and certain features of particular interest are presented.

#### REPORT OF CASES

CASE 1—A boy aged 9 had had chronic suppurative otitis media for seven years. The disease began as a complication of scarlet fever, at the age of 2 years, and persisted, with the usual periods of exacerbation and remission. No aural therapy had been given. Except for tinnitus, there were no subjective symptoms. Examination showed that the tonsils were hypertrophic. The left tympanic membrane appeared normal, the right tympanic membrane showed a large central perforation, through which a small amount of odorless pus drained into the external auditory canal. The diagnosis was obviously chronic otitis media, without osseous necrosis. During examination a peculiar clicking, rhythmic noise was heard coming apparently from the right ear. This rhythm was not synchronous with the apex beat and the radial pulse. It occurred at the average rate of 100 a minute. The ticking was constant, and inquiry revealed the fact that three years previously the boy had told his parents that he heard a clock tick in his ear. No attention was given the matter, although the noise was evident to the parents when they approached the boy's right ear. Inflation of the eustachian tube produced no change in the rate or rhythm of the sound. At times slight movements were observed in the soft palate, but no muscular contractions were seen about the face. A moderate degree of conduction deafness was revealed on the right side. Digital examination showed a large amount of adenoid tissue in the postnasal space.

Tonsillectomy and adenoidectomy were performed. The discharge ceased after two months of conservative treatment, the large perforation remained open. At present (April 1934) there has been no change in the tinnitus, though the ear is dry after a period of twelve months. The patient is not annoyed by the ticking, on the contrary, he considers it rather interesting to have a "watch in his ear."

CASE 2—A white woman aged 45 was under treatment for one year for hypertension. There were repeated attacks of epistaxis, until one such attack required

8 Bárány, R. Zur Aetiologie, Therapie und Theorie der objective-subjectiven Ohrgerusche, *Acta oto-laryng* 16:311, 1931.

9 Passow, A. Objective Ohrgerusche, *Internat Zentralbl f Ohrenh* 8:511, 1910.

10 Hamburger, L. P. Head Murmurs, *Am J M Sc* 181:756, 1931.

the use of a postnasal pack. She was admitted to the hospital two days later, after which she was first seen by me. At this time the pack was removed, and the bleeding was stopped by cautery. The patient was discharged from the hospital in good condition. Acute suppurative otitis media developed in the left ear five days later. Owing to the absence of pain and to the fact that little discomfort was felt, the patient did not seek medical aid at this time, and the tympanic membrane ruptured spontaneously. Three days after the onset of the discharge from the ear the patient again consulted me, complaining that she could not sleep and was extremely nervous because of a pounding noise in the left ear. This seemed to keep time with the heart beat and was present whether she was in an upright position or was recumbent. Its intensity had not varied for twenty-four hours. Examination of the left ear disclosed a small perforation in the lower anterior part of the ear drum. A serosanguineous material was discharged through the perforation apparently under great pressure. Deafness was present in the left ear. A strong rhythmic sound was heard through the stethoscope all along the left side of the neck. With the auscultation tube the noise was observed to be intensified in the left ear and was synchronous with the heart beat. Turning of the head to either side brought no change in the intensity of the sound. Compression of the left carotid artery decreased the sound considerably. Sedatives were prescribed. Subsequent daily examinations revealed a gradual decrease in the intensity of the sound. After the fifth day it could no longer be heard by the observer, but not until the seventh day had the subjective tinnitus disappeared. The ear became dry after two weeks, and normal hearing returned. The blood pressure of the patient, taken daily while she was under observation, showed the following variations: January 18, 175 systolic and 90 diastolic, January 19, 160 systolic and 90 diastolic, January 20, 132 systolic and 80 diastolic, January 21, 155 systolic and 90 diastolic, January 22, 128 systolic and 80 diastolic, January 23, 148 systolic and 85 diastolic. Subsequently the systolic pressure remained about 150.

The proximity of the carotid canal to the middle and internal ear probably played a role in the production of this type of tinnitus. The inflammatory process in the middle ear may directly or indirectly involve the surrounding structures to a sufficient extent to allow the pulsations from that vessel to be transmitted strongly to the ear. The sound was of vascular origin, since it was synchronous with the heart beat. This transitory type of objective vascular tinnitus has not previously been reported in the literature.

CASE 3—A white woman aged 51 consulted Dr. Francis L. Lederer because of deafness, tinnitus and pain in the right ear, of many years' duration. On two occasions the ear drum was incised by physicians because of the findings, and each operation resulted in intractable hemorrhage, necessitating packing. The first inspection of the ear drum revealed nothing unusual, and the subjective noise in the ear on which the patient insisted was thought to have purely a functional basis. However, on closer inspection of the drum a dark red area was observed, involving the posterior superior quadrant and most of Shrapnell's membrane. The patient was so insistent that the tinnitus was audible that a diagnostic tube was placed in the external canal and a definite blowing sound was heard. With the aid of a magnifying otoscope, pulsations of the discolored portion of the tympanic membrane were readily seen. Dr. Joseph Beck also examined the patient and verified the findings already described.

Roentgenograms of the mastoid revealed rarefied areas. In view of the progressive deafness and the increasing severity of the other symptoms, an exploratory

operation was undertaken. Considerable difficulty attended mastoidectomy because of excessive hemorrhage. The bony trabeculae of the mastoid were intact, but each cell was filled with a soft granulomatous mass, which became the source of almost uncontrollable bleeding. The mastoid process, the antrum and the upper portion of the middle ear were all filled with this tissue. Its exact origin could not be determined, owing to the extreme amount of bleeding. A radical mastoidectomy was performed, a plastic and a firm pack completed the operation.

About four days after the operation facial paralysis appeared. Repeated attempts were made to remove the pack, in order to relieve the pressure which appeared to cause the palsy. The removal of the pack after two weeks was still attended by bleeding. Not until skin flaps had been brought down and the area covered completely with skin did the hemorrhage cease. The facial paralysis eventually disappeared, as did the subjective tinnitus.

Eight years after the operation the patient is free from subjective tinnitus. However, a distinct bruit can still be heard with the aid of an auscultation tube.

#### COMMENT

It is generally agreed that objective tinnitus may be produced in either of two ways, namely, by disturbances of the vascular system about the head and neck or by contractions of the muscles around the eustachian tube. The muscular type of tinnitus always produces a noise characteristically regular and rhythmic, either clicking or ticking, at the rate of about 100 per minute.

Bárány's<sup>8</sup> combined objective-subjective type of tinnitus is an unnecessary subdivision, for, by definition, if the sounds cannot be heard on examination the tinnitus should be classified as subjective.

The origin of the sounds heard in the muscular type of objective tinnitus has been explained in a number of ways. The suggestion that the noise may be the result of friction of the ossicles or of vibration of the drum membrane does not appear to be tenable. Contractions of the stapedius or of the tensor tympani muscle seems to be too delicate an action to produce noises audible to an observer. The only explanation of the origin of these sounds for which definite evidence has been offered ascribes it to the clonic contractions of the muscles about the eustachian tube and the soft palate, the opening and closing of the eustachian tube, with the accompanying alternate separation and contact of the two moist surfaces, best explains the peculiar clicking sound. Hysteria and neurasthenia have been hypothecated as predisposing or contributing factors. Since such conditions are uncommon in children and since it is in children that this type of tinnitus always occurs, this explanation is not plausible. Some cases of this type of tinnitus have been reported in which the symptoms disappeared and reappeared, but in case 1 the ticking has been constant on repeated examinations and the patient is unable to control it. So far as I have been able to determine, no case has been reported in which it was possible to arrest the noise permanently, but the absence of instances of the muscular type of tinnitus in adults shows that a spontaneous cure probably occurs as the child grows up.



The vascular type of objective tinnitus, whether of arterial or of venous origin, is the more common and is heard only with the aid of the stethoscope or the auscultation tube. Its most frequent causes are (1) aneurysms, including arteriovenous aneurysms, both intracranial and extracranial, (2) hypertension, (3) vascular tumors of the brain and the ear, (4) coarctation of the aorta, (5) severe anemias, (6) pregnancy, (7) acute inflammatory disease of the ear, and (8) vasomotor and endocrine disturbances.

In the arterial type of objective tinnitus the sounds are synchronous with the heart beat, if the carotid artery is the direct cause, they may be eradicated or modified by its compression. Nonpulsating noises which are soft and humming are venous in origin and are found in cases of severe anemia. The tinnitus in Iglauer's<sup>7</sup> cases must have been arterial in origin, since he reported that the sound was rhythmic, synchronous with the heart beat and modified or eliminated by pressure on the carotid artery.

The cure of the tinnitus in Lederer's case indicates that he removed the part of the tumor in close proximity to the structures of the inner ear which had caused the subjective tinnitus, but left a pulsating mass sufficient in size to permit the sounds to be heard with the auscultation tube. Treatment of the vascular type of tinnitus depends on the cause. Aneurysms are subjected to such forms of treatment as are feasible in the particular case. Ligation of the carotid artery has been advised to relieve tinnitus, but in the vast majority of cases this method of treatment has not had a favorable result. Further, since the method carries with it a relatively high mortality and morbidity in adults, it has a limited field of application. In the venous types of tinnitus, usually due to anemia, the tinnitus ceases with improvement of the underlying pathologic condition and with restoration of the proper constituents of the blood. Elimination of the cause in the transitory type of tinnitus, such as that associated with pregnancy and inflammation, usually results in a permanent cure. The use of the stethoscope and the auscultation tube as a routine by otologists in examination of sufferers from tinnitus would, I believe, reveal many cases of unsuspected objective tinnitus.

#### SUMMARY AND CONCLUSIONS

Three cases of objective tinnitus are reported. Similar cases described in the literature are reviewed.

Objective tinnitus may be either vascular or muscular in origin.

Spasmodic contractions of the eustachian tube are the chief causative factors in the muscular type of objective tinnitus, the immediate cause is the separation of the moist surfaces of the eustachian tube.

The vascular type of tinnitus is caused by the preternatural transmission of arterial or venous impulses to the ear.

Dr Francis L. Lederer placed the records in his case at my disposal.

# BRONCHIAL ASTHMA AND NASAL ALLERGY

MAXIMILIAN A. RAMIREZ, M.D.

NEW YORK

I have chosen bronchial asthma as my subject so as to avoid becoming involved in a controversy regarding strictly otolaryngologic matters with which I have had little experience and on which I certainly could contribute nothing in a group such as this. A brief general review of the internist's point of view in the classification and management of asthma may be of some interest.

The importance of pathologic conditions of the nose in asthma cannot be emphasized too much. The exact relation between nasal and sinus findings and asthma is often difficult to determine. They may bear no relation to each other, on the other hand, both may be of allergic origin and caused by the same allergen, as in pollen asthma associated with hay fever, or they may be due to entirely unrelated substances. What constitutes proper procedure in the management of the condition in individual cases is not always easy to decide, there is considerable difference of opinion, and the problem requires the careful expert consideration of both the rhinolaryngologist and the allergist-internist. I say allergist-internist because I consider allergy an integral part of a major specialty. I do not think that one can competently treat the many clinical manifestations of hypersensitiveness as related to the various systems of the body from a strictly so-called allergic standpoint without either adequate training in the particular field concerned in the allergy or close cooperation with a specialist in that field. Asthma requires the attention of an internist well trained in allergy, and in the cases to be discussed, in which pathologic conditions of the nose play a prominent part, the internist must work with a rhinologist.

## CLASSIFICATION

In discussing asthma one of the most difficult things to do and yet the first thing that one must do is to decide whether or not one is dealing with true uncomplicated asthma. Much confusion at times arises in differentiating paroxysmal dyspnea caused by a foreign body in a bronchus, pressure on the trachea at some point, marked pulmonary fibrosis sufficient to displace the trachea or enlarged hilar lymph nodes from

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true bronchial asthma. Here another difficulty is encountered—that of agreeing on a definition, whether asthma should be considered as a clinical entity or merely as a symptom of any number of dysfunctions. I am going to consider bronchial asthma as a clinical entity and define it as a bronchial neurocellular syndrome characterized by recurrent attacks of paroxysmal dyspnea. It may be classified in any number of ways, none of which is entirely satisfactory, some classify it as allergic or nonallergic. This I do not like, because in the present state of

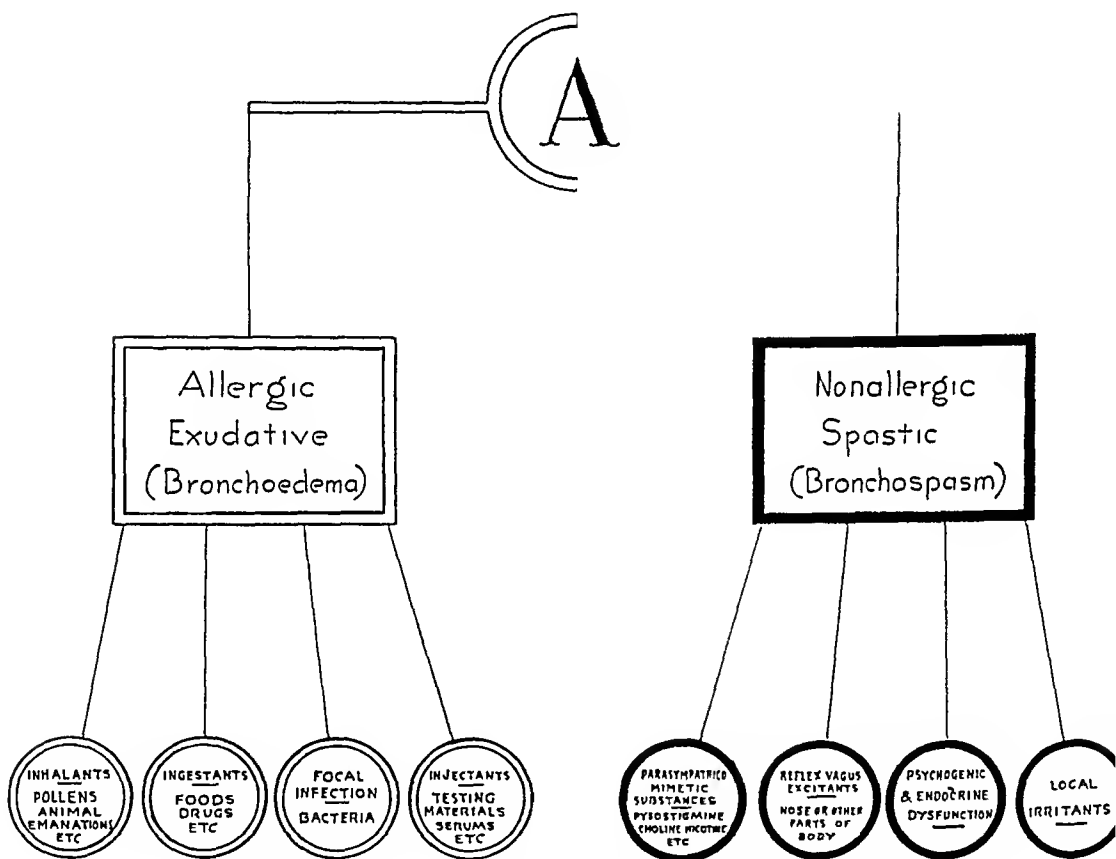


Fig 1—Diagrammatic representation of pathologic classification of asthma

knowledge regarding allergy—and particularly regarding sensitization tests, about which I shall say more a little later—the large number of cases put under the nonallergic heading are often placed there because it has been impossible to demonstrate an allergic relationship, which does not necessarily mean that the symptoms are not due to an allergen but indicates only that the allergen has not been found. Some classify asthma as extrinsic or intrinsic, this division also I do not like. I prefer a classification that attempts to convey to one's mind something suggestive of the actual pathologic condition. I have divided asthma into two large types, (1) bronchoedematous and (2) bronchospastic.

The bronchoedematous type, in which there is edema of the bronchial mucosa, includes asthma due to sensitization to an allergen, truly non-allergic asthma due to remote stimulation by some other excitant, such as a pathologic condition of the nose, the effects of heat and cold or emotion, manifests not bronchoedema but bronchospasm.

That actual bronchospasm may occur as a result of stimuli originating in some distant part of the body has been adequately demonstrated, the fact that swelling of the bronchial mucous membrane occurs in sensitive subjects also has been shown repeatedly. I do not mean to imply that in the bronchospastic type there is no bronchoedema and vice versa, for I can readily see that swelling of the bronchial mucous membrane with interruption of proper local function may result almost immediately in bronchospasm and, conversely, that spasm would soon be followed by edema. Therefore, in most cases in actual practice the condition is of mixed type pathologically, even though etiologically it belongs fundamentally to one type or the other.

#### DIAGNOSIS

It seems unnecessary at this late date to emphasize the necessity of a careful taking of the history, thorough physical examination and complete laboratory and roentgen analysis, as well as tests of sensitization. In this connection, however, there is just one point which I think has received and is still receiving entirely too much emphasis. That is heredity. A great deal has been written about heredity in allergy, and some authors have expressed the belief that the presence or absence of allergy among the antecedents is an important indication of the category in which to place a condition. I have taken exception to this on the ground that it leads to error. It is impossible to obtain reliable information from a patient regarding the incidence of allergy among his or her antecedents. Some of the first published statistics on heredity in allergy included as evidence of allergy only hay fever and asthma, later reports included certain types of eczema, then urticaria, migraine and gastrointestinal disturbances, and now, when nearly every system and tissue in the body is recognized as a possible seat of allergic phenomena, it seems to me that practically all persons are potentially allergic in one form or another. Even a casual perusal of figure 2 will, I think convince the reader of the undependability of statistics on heredity in allergy.

#### SENSITIZATION TESTS

The development of the cutaneous test as a means of determining specific hypersensitiveness has, of course, done much to enhance knowledge of and stimulate interest in this field. It is important that every practitioner should fully appreciate the fallacies of these tests, so that

he may more fully grasp their true significance and value. One must not condemn the entire field of clinical allergy and underestimate its importance merely because of the inadequacies and inaccuracies of sensitization tests as performed today. There is no question but that there are many pitfalls, one frequently observes positive cutaneous reactions to substances having clinically nothing to do with a patient's symptoms, and one may fail to obtain reactions to substances known to be important etiologic factors. Occasionally one obtains a positive reaction in one area of skin and a negative reaction in another. Cases of remarkably localized sensitivity are interesting, for example, a physician with sea-













Question: Did you Mother or Father or Maternal Grandmother or Grandfather or Paternal Grandmother or Grandfather have Hay Fever?	Yes 115 or 23%	No 385 or 77%	Yes  No 
Question: Did your Mother or Father or Maternal Grandmother or Grandfather or Paternal Grandmother or Grandfather have Hay Fever or Asthma?	Yes 150 or 30%	No 350 or 70%	Yes  No 
Question: Did you Mother or Father or Maternal Grandmother or Grandfather or Paternal Grandmother or Grandfather have Hay Fever or Asthma or Eczema?	Yes 235 or 47%	No 265 or 53%	Yes  No 
Question: Did you Mother or Father or Maternal Grandmother or Grandfather or Paternal Grandmother or Grandfather have Hay Fever or Asthma or Eczema or Urticaria?	Yes 309 or 61.80%	No 191 or 38.20%	Yes  No 
Question: Did you Mother or Father or Maternal Grandmother or Grandfather or Paternal Grandmother or Grandfather have Hay Fever or Asthma or Eczema or Urticaria or Migraine?	Yes 338 or 67.60%	No 162 or 32.40%	Yes  No 
Question: Did you Mother or Father or Maternal Grandmother or Grandfather or Paternal Grandmother or Grandfather have Hay Fever or Asthma or Eczema or Urticaria or Migraine or definite gastric and gastrointestinal disturbances?	Yes 485 or 97%	No 15 or 3%	Yes  No 

Fig. 2—Five hundred patients varying in age from 15 to 60 and giving a clear-cut history of seasonal hay fever and positive reactions to cutaneous, inhalation and passive transfer tests with one or more pollens were carefully questioned regarding allergy in the mother, the father and the maternal and paternal grandparents. The answers have been tabulated in six groups, which clearly show the inaccuracy of statistics relating to heredity in allergy.

sonal asthma had negative reactions to cutaneous, ophthalmic, passive transfer and inhalation tests in the nose. However, this patient reacted immediately to the inhalation of ragweed pollen directly into the lungs.

#### MANAGEMENT

As I stated before, in the majority of cases the condition is of mixed type, therefore, the average patient requires care from both the allergic and the nonallergic angle.

Obviously, further contact with an offending allergen, once it has been definitely established, should be avoided. A careful inspection of the patient's home is helpful, it is amazing to note the queer and unsuspected sources of exposure and contact which one may discover by a systematic and thorough search. For example, a patient sensitive, let me say, only to ragweed may have severe attacks of asthma at odd times of the year due to exposure to pyrethrum, which belongs to the same botanic family as ragweed. The substance is found in most insecticides, such as flit, and is used to spray the upholstery in automobiles, draperies, and upholstered chairs. Patients sensitive to cattle hair are exposed to this allergen in the form of ozite, which is a matting or padding to be placed under carpets and rugs and which is made almost entirely of tightly pressed cattle hair. Children's toys are often made of cattle hair or rabbit hair. I could cite any number of interesting examples of unusual forms of exposure to various allergens. A point of practical importance is that at times a patient will give a positive reaction and be shown to be sensitive to feathers in his own pillow and still give a negative reaction to a stock extract. Why this is I do not know, but it does happen, therefore, I usually test with extracts of materials collected from the patients' home as well as with the stock extracts. A growing interest in molds and fungi is being shown, therefore, this source of sensitization should not be overlooked.

The intestinal tract must be kept free, this is of great importance with all types of asthma.

Time does not permit me to discuss my observations on the value of medication with hydrochloric acid, with peptone and with calcium, of intratracheal administration of iodized poppyseed oil, of roentgen irradiation, of bronchoscopic treatment and of other nonspecific procedures, but I should like to say just a few words about the use of iodides. It has been repeatedly stated that it is unnecessary to give iodides intravenously, as they act just as efficaciously when given by mouth. I must disagree with this opinion. I am convinced that iodides administered intravenously in the form of sodium iodide give better results in the treatment of asthma than do iodides given by mouth. Furthermore, for several years I have administered large doses of iodide intravenously once or twice a week, giving as much as 250 cc. of a 4 per cent solution. This represents 10 Gm. of sodium iodide, as against the usual dose of 2 Gm. The results have been extremely gratifying, and in not a single instance has there been any untoward effect.

I must now pass to the management of nasal and sinusal pathologic conditions and asthma. If there is any free pus in the sinuses, naturally there is no question but that adequate measures should be instituted to eliminate it. When the pathologic picture consists of, let me say, a

thickened membrane in the antium or the presence of polyps in one or both antiums, then the decision is not so simple or so cut and dried. Some competent otolaryngologists insist that in such cases operative measures should not be taken, because the patient is generally allergic and if one eliminates the offending allergen the thickened membrane and polypoid tissue recede. It is my humble opinion that otolaryngologists have gone from one extreme to the other. Formerly operative measures were taken in all these cases, and allergy was given no recognition. Now allergy is being accorded a great deal of importance, and many patients with involvement of this type who will not get well except by operation are not operated on but are kept on rigid diets and given long series of injections of numerous allergenic extracts. In cases of asthma in which true polyps are present, I am convinced that satisfactory results will not be obtained merely by eliminating offending allergens or by attempts at hyposensitization. The pathologic condition must be corrected surgically.

It is interesting to note that frequently antral washings may be sterile while cultures of the lining membrane yield pure growths of one or another organism to which the patient may have become allergic and to which one obtains definitely positive cutaneous reactions. In cases in which this is true examination of the tissue often shows a marked increase in eosinophils and the eosinophils in the circulating blood are as a rule increased. In these cases administration of autogenous vaccines after operation gives the best results. When cultures of tissue are sterile and there is no local or general eosinophilia, no benefit may be expected from vaccines. When culture of tissue yields a positive bacterial growth but there is no local or general eosinophilia and the cutaneous reaction to the autogenous bacterial suspension is negative no help is derived from vaccines. There are two other combinations that I should like to mention because of their practical importance in treatment and because my data represent many years of careful follow-up. 1 In cases in which antral washings yield a positive bacterial growth culture of tissue is sterile, there is no local eosinophilia of the tissue but an increase in the eosinophil content of the blood and the cutaneous reaction to the autogenous bacterial suspension is positive vaccines should be employed. 2 In cases in which organisms are isolated from the antral washings, culture of tissue is sterile, there is no eosinophilia of the tissues or of the blood and the cutaneous reaction to the bacterial suspension is negative, vaccine treatment should not be given, as it has no particular value.

I do not want to be misunderstood regarding the question of the allergic basis of thickened membranes or polyps in the sinuses. There is no doubt that many patients with such sinusal involvement are allergic

and should not be operated on. I do not refer to those thickened membranes or polyps in the sinuses which cause only local symptoms. I am discussing bronchial asthma believed to be due to a nasal pathologic condition. The bronchospastic type of asthma resulting from remote reflex stimuli originating in the nose or the accessory sinuses obviously will not be benefited except by elimination of the local pathologic con-



Fig 3—Section of tissue removed from the antrum in a case of bronchospastic nonallergic reflex asthma, showing round cell infiltration. No eosinophils are present.

dition. It is my opinion that even in cases of bronchoedematous asthma in which sensitization has taken place a gross nasal pathologic condition must be corrected surgically if lasting satisfactory relief of symptoms is to be expected, this, of course, must be in addition to proper treatment from an allergic standpoint. It is imperative in these cases to establish thorough cooperation between the allergist and the rhinologist.



There is just one more point which I should like to bring out, and that is an observation which I think is extremely important and may explain the cause, at least in some cases, of a persistence of asthmatic symptoms for weeks or even months after the pollen season in cases in which the condition is strictly attributable to pollen. For example, an asthmatic person who is sensitive only to ragweed presents ordinarily a problem just as strictly seasonal as that presented by one who has

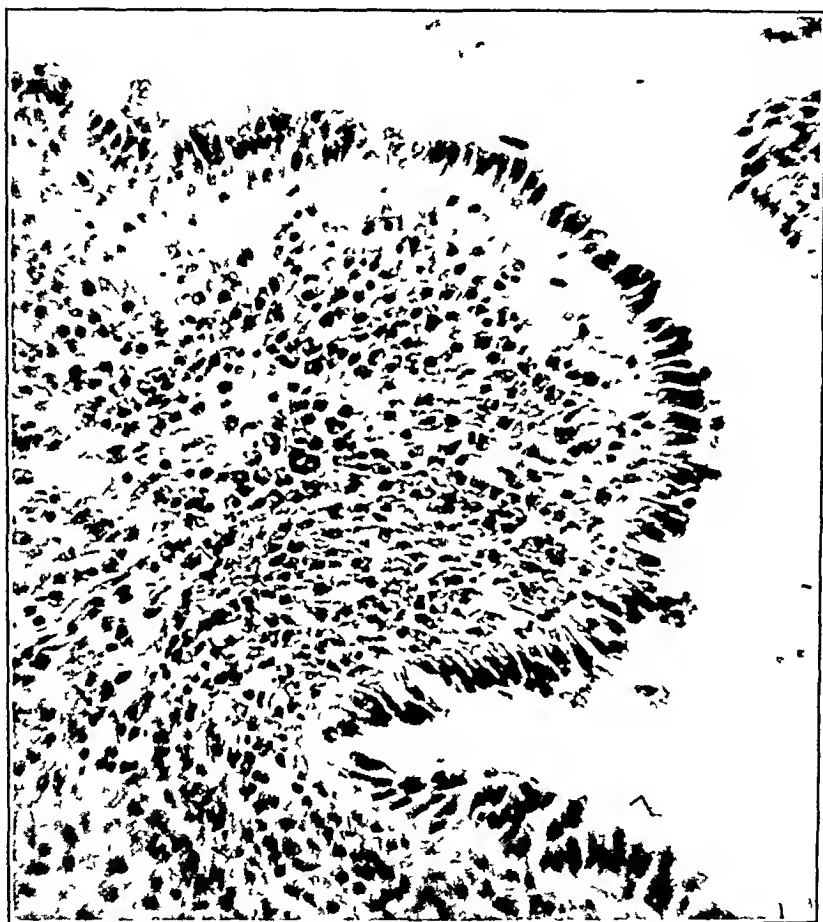


Fig 4—Section of tissue removed from the antrum in a case of local and systemic allergy, showing marked increase in eosinophils

hay fever due to ragweed. However, at times—in fact, rather frequently—one sees symptoms in patients with this type of asthma after all ragweed pollen has disappeared from the air in the particular locality I believe and think that I have demonstrated, that the pollen grain becomes embedded in the lining membrane of the antrums and possibly of the other sinuses and is in this way responsible for the continuance of symptoms in highly sensitive persons. I have obtained specimens of tissue from the antrum by means of a specially designed punch and

by curettage and have made extracts of this tissue in Coca's solution and with 14 per cent alcohol. Positive cutaneous reactions have been obtained with these extracts in ragweed-sensitive subjects and no reaction in patients that do not react to ragweed. Passive transfer studies in which the tissue extract was used as the testing allergen to demonstrate the presence of ragweed reagins passively transferred have further corroborated these observations. Twenty cases have been carefully studied from this angle, and in 4 the findings were positive.

In closing, I should like just one word about the importance of endocrine glands and of vitamins in bronchial asthma, these are phases of the subject which one hesitates to discuss because of the present lack of knowledge. I believe that there is a definite relation of endocrine dysfunction and vitamin deficiency not only to asthma but to allergy in general. I do not think that any one gland or a deficiency in any one vitamin is solely responsible. Any gland or combination of glands may be an important factor affecting the underlying fundamental mechanism of hypersensitiveness. I believe that this phase of allergy indirectly may involve a strong hereditary influence and determine the shock tissue.

If I have accomplished nothing more, I hope that I have at least succeeded in further stimulating interest in this fascinating subject.

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# CHOLESTEATOMA VERUM OF THE RIGHT MASTOID

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AND

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Cholesteatoma verum within the cranial cavity is rare, and this disease in the mastoid, that is cholesteatoma without a history of a sign of aural infection, is even rarer

## REPORT OF A CASE

J K, a white man aged 25, an American, was referred to one of us (M D F) by Dr M A Weitz for neurologic examination on April 23, 1937. The story was as follows. About two months previously a friend of the patient had called his attention to the fact that his face "seemed crooked." The patient then noted that he could not move the right side of his face. He was advised that the condition was Bell's palsy and that it would clear up in time. However, as the weeks went by he could see no improvement in the facial movement, and he therefore consulted Dr Weitz. The history further revealed that in February 1936 he had noted that the right side of his face "twitched spasmodically at times." He could feel twitchings in his cheek and chin, which recurred at short intervals. These twitchings continued for about two weeks and then cleared up entirely. Six months later he noted the twitchings again, but for only a half a day. Once more they cleared up.

He was then perfectly well until February 1937. He had no headache, no nausea, no vomiting, no olfactory disturbance and no trouble with swallowing. The general physical examination gave negative results. The neurologic examination revealed the following positive findings. Facial paralysis of the peripheral type was present on the right side. There was definite impairment of hearing on the right side, but a 256 double vibration tuning fork could be heard by air conduction. Inspection of the aural canals showed marked narrowing of the right external canal near the inner one third on the external wall. The membrana tympani was entirely normal and glistening white. Taste was normal. Because of the impairment in hearing and the narrowing of the right canal we made a diagnosis of facial palsy secondary to an expanding lesion which was encroaching on the external canal. With this in mind, we had a roentgenogram of the skull taken with particular reference to the mastoid region. Plates were taken by Drs Friedman and Mahrer, and it was their interpretation which led to the preoperative diagnosis of cholesteatoma. Their report was as follows:

"The right mastoid is densely sclerotic and entirely devoid of cellular outlines. The cortex is greatly thickened, and there is diminished density of the antrum close to the sinus, suggesting early cholesteatoma formation. The right pyramid shows a loss of continuity of the lateral portion of the superior margin but



Fig 1—Anterior-posterior view of the skull for comparison of the mastoid regions

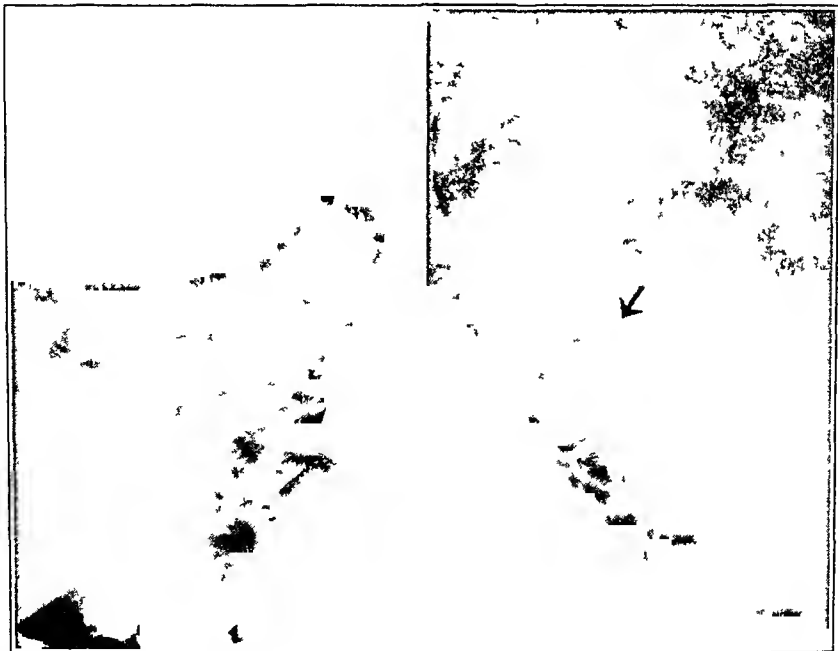


Fig 2—The two mastoids

is otherwise fairly cellular. There is no thickening of the margin, and the calcium content appears to be normal. Impression: sclerosed right mastoid, with possible early cholesteatoma and involvement of the right petrosa."

The laboratory work gave essentially negative results. A spinal puncture done preoperatively revealed an increased pressure (270 mm of water). Response to compression of the left jugular vein was prompt and adequate, while with compression of the right jugular vein there was a slow rise of only 5 mm (water manometer). In view of the roentgen findings it was deemed best to approach the lesion through the right mastoid. On April 26 the patient was operated on by Dr. Quittner. As soon as the cortex of the right mastoid was removed (it was thin but very hard) a glistening white membrane was visible.

As the facial wall was approached one could see where the cholesteatoma had absorbed the bone in the external canal, causing the bulging of the external



Fig. 3—The tumor as it appeared at the operation

wall. Figure 3 shows the tumor after all the superficial external bone had been removed. Removal of the cholesteatoma toward the antrum was carried out. As the facial nerve was approached careful removal disclosed the nerve free in debris to the extent of about 1.5 cm. The nerve was brownish. The external semicircular canal was intact. The debris did not involve the middle ear, and therefore the aditus was not touched. Where possible the glistening capsule was left intact, as in the upper and the middle parts.

Fearing encroachment on the lateral sinus because of absorption (as shown by the compression test), Dr. Quittner attempted careful removal in this area. With the barest removal of debris, however, a gush of venous hemorrhage took place. Pressure was placed at this point, and attempt was made to clean out the debris above. Another venous gush occurred. No further attempt was made, and with a pressure pack on the sinus the cavity was temporarily closed until thrombosis took place.

No general reaction to the operation occurred except a slight rise of temperature for two days. Five days later removal of the pack showed that thrombosis was present, and the cavity was reopened. The remainder of the debris over the sinus was removed. The facial wall was lowered, but as the aditus and the membrana tympani were normal, no work was done in this area. A Kerner plastic flap was turned into the cavity, with a large portion left below to roll over the exposed part of the facial nerve.

The patient was discharged from the hospital on May 9.

At the time of writing the ear is dry, the glistening wall of the capsule is clearly seen in the mastoid cavity and the membrana tympani appears normal. Hearing for the conversational voice close to the ear is excellent. The facial nerve has shown progressive recovery, so that the patient is able to move all his facial muscles to some extent, and the range is increasing regularly.

#### SUMMARY

Primary cholesteatoma of the mastoid is rare. Pathologically, the tumor in our case was diagnosed as an epidermoid cyst. It produced peripheral facial paralysis, which had been diagnosed as Bell's palsy. Surgical removal of the tumor cured the facial paralysis.

Mount Sinai Hospital

# PSYCHIATRIC THERAPY FOR DYSPHONIA

APHONIA, PSYCHOPHONASTHENIA, FALSETTO

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NEW YORK

The so-called functional disorders of the voice are presumably of psychic origin, with no organic involvement. However, it has slowly been realized that biologically one can never classify a disorder as purely functional or purely organic. It is always a question of considering the organism as a whole, that is, considering all the phases of the person's makeup—mental, physical and emotional.

While it is important to know how mature a person is physically and mentally, it is equally—if not more important—to know how mature he is emotionally. This is particularly true when one considers that an innate tendency toward emotional and nervous instability underlies the neuroses and that, to a greater or lesser degree, the dormant seeds of a neurosis are present in all human beings. That is, all persons are liable to peculiar states of tension or irritability of the nervous system.

These states, which underlie the neuroses, are generally not regarded as organic, but are considered as behavior states. The general idea that these conditions have a nonphysical basis is predicated on the absence of any evident lesions. Observations, however, definitely point to the facts that some persons show marked evidence of an inherited neuropsychic diathesis and that, regardless of the absence of any evident lesions, the abnormal behavior of a person depends on defects, limitations or faulty action of his anatomic mechanism.

Harrington<sup>1</sup> pointed out the fallacy of regarding behavior states as purely functional, said that "the cause of abnormal behavior is to be found in the unfitness of the organism for its environment" and that "this unfitness of the organism for its environment is due to three factors—defective heredity, defective education, and defective bodily health."

Neuroses, then, should never be considered apart from the organism, but should be regarded as an integral phase of that organism.

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Read before the Section of Otolaryngology of the New York Academy of Medicine, April 20, 1938

1 Harrington, M. A Biological Approach to the Problem of Abnormal Behavior, Lancaster, Pa., The Science Press Printing Company, 1938, p. 442



A neurosis as it develops may take on various definite forms, but the commonest of all are the anxiety states, in which the person is continually in a state of fear, expressed both physically and mentally. This fear, which is termed neurotic anxiety, is perceived psychically as an unknown danger threatening the personality.

The persons suffering from the disorders of the voice which I am about to consider all demonstrate neurotic anxiety of one form or another. They are in a constant state of nervous tension, and all fall under one general classification—neurotic persons of the sympathicotonic type. Although their respective clinical pictures vary in the number, character and intensity of the presenting symptoms, certain subjective and objective symptoms are common to all of them.

They are tense, restless, apprehensive and uneasy, and they show a marked lability of the pulse and blood pressure, with unusual tachycardia when under emotional stress. They are generally afflicted with hyperhidrosis and have cold, clammy hands and feet. While the basic metabolic rate is normal or only slightly below normal, they demonstrate a tendency toward marked fatigue.

Further, these patients possess a relatively high potential for the spread of emotional tone (that is, a tendency for dominance of the sympathetic division of the vegetative nervous system) which far overreaches that of the normal person. Anxiety neuroses and phobias of various kinds are common, and nervous instability is usually found to be a familial trait. In the words of Dr. Stanley Cobb,<sup>2</sup> these persons are "born tender and are exquisitely vulnerable to the hurts of the world."

In temperament they are generally absorbed with themselves and self centered (narcissistic). In their contacts with the external world they are rather aloof, subjective and egocentric—all of these traits usually being defense mechanisms against basic anxiety and feelings of inadequacy or inferiority.

Such persons, in order to escape from an intolerable situation, will often convert their unconscious neurotic anxiety into a physical manifestation. Quite frequently this process of conversion is located in the vocal tract, as is seen in the various forms of dysphonia, such as psychophonasthenia, hysterical aphonia and, in many cases, falsetto voice.

#### PSYCHOPHONASTHENIA

The first form of dysphonia—psychophonasthenia—for years has been erroneously diagnosed as weak voice, phonasthenia. The symptoms of this disorder are variable, but the patient usually complains of a

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<sup>2</sup> Cobb, S. Review of Neuropsychiatry for 1937, *Arch Int Med* 60:1098 (Dec.) 1937.

tight, constricted throat, uncontrollable choking sensations when speaking and strained voice which lacks carrying power. To the listener his voice presents other marked characteristics. It is strident, rasping, grating—a croaking, pinched voice with irregularities of pitch.

The condition has been variously attributed to a forced technic, as overfatigue in singers and speakers, to local involvements of the organs of speech, and to physical or mental sufferings.

The slight lack of approximation of the vocal cords or irregular contact of the cords, or even a slight congestion which is often noticed, is usually not enough cause for the chronically strained condition of the voice. Laryngologic findings are negative, because the condition is not dependent on local pathologic changes but is due to psychic factors that have their roots in the atypical constitutional makeup of the person and in his atypical psychologic development.

Although the patient always complains of unusual effort and fatigue, there is no causal fatigue laryngologically and no local involvement, but there is a decided causal psychic state. The vocal manifestation is merely a symptom of the person's neurotic anxiety.

States of anxiety in combination with such a patient's tendency toward emotional imbalance cause misdirected laryngeal effort, to which, in the course of time, he becomes conditioned. Since the problem is fundamentally psychic—emotional—this condition has come to be designated at the National Hospital for Speech Disorders as psychophonasthenia.

Paradoxical as it may seem, these patients suffer not from a weak larynx or from functional fatigue of the voice as pointed out by Flatau,<sup>3</sup> Froschels<sup>4</sup> and others, but from a larynx which in reality is over-powerful.

The patient, never realizing the psychic origin of his condition, erroneously seeks to help himself through laryngeal action. He uses his larynx as an instrument of pressure instead of as an instrument of performance. He inhibits the production of voice through muscular pressure, vocalizing *with* his throat instead of *through* his throat.

The psychophonasthenic patient's method of vocalization diminishes the carrying power of his voice. Exaggerated pressure causes the thyroid cartilage to be drawn up to the hyoid bone, so that the arytenoids are rotated on their facets, being articulated with the cricoid cartilage. Thus the vocal cords are adducted to a tighter contact and in their movements create greater friction, which results in a tense form of phonation instead of a normal resonant voice.

3 Flatau, T. S. Die funktionelle Stimmchwäche (Phonasthenie) der Sanger, Sprecher und Kommandorufer, Charlottenburg, G. Birkner, 1906.

4 Froschels, E. Lehrbuch der Sprachheilkunde (Logopädie) für Aerzte, Pädagogen, und Studierende, ed. 1, Leipzig, Franz Deuticke, 1925.

All this process is merely a "physiologizing" of the emotions. Because of his constitutional makeup and his atypical psychologic development, the person acquires an unconscious fear or feeling of inadequacy—a fancied or real inability to measure up to a necessary standard in a competitive world—which in the course of time results in a neurosis.

The patient's extreme laryngeal manifestations may be said to be a deficiency specialization—a hysterical mechanism which he uses as a defense. This is borne out by the fact that the condition usually develops during late adolescence or during adulthood and is most often observed in those whose vocations especially call for public contacts—ministers, lawyers, singers and many others.

#### HYSTERICAL APHONIA

Another type of patient will now be considered, whose cardinal symptom is likewise misleading—the patient who suffers from hysterical aphonia or functional loss of voice. The physical dysfunction, like that of the psychophonesthenic patient, is due to neurotic background and psychic influence, but the onset, course and nature of the two conditions are markedly different.

In hysterical aphonia the onset of the disorder is relatively sudden and acute rather than gradual and cumulative. Since the patient almost invariably loses his voice after a "cold," the organic plausibility of the symptom is extraordinarily thorough. On examination, however, the laryngologic findings, with certain minor exceptions, are almost invariably negative.

A complete anamnesis will usually reveal that the condition of the voice is just a vocal projection which masks the patient's underlying difficulty—it is a neurotic escape from an environment which is distasteful or which threatens his security or happiness.

A brief resume of a few cases will illustrate the nature of this disorder and the most efficacious type of therapeutic procedure.

*Type One*—J. G., a married woman aged 30, had suffered recurrent loss of voice for the past four years. She had had many forms of treatment, including tonsillectomy, treatments of the throat and the sinuses and a series of injections, with no permanent results. Roentgenograms also were taken to allay suspicion of tuberculosis.

The patient came under observation at the clinic six months ago. The anamnesis revealed that she unconsciously resented the affection her husband bestowed on their children. It was a blow to her narcissism. Her unconscious solution was to gain his attention by the "physiologizing" of her emotions through a conversion mechanism.

The patient was persuaded, through psychiatric counsel and suggestion, to accept the true meaning of her symptom and has talked normally ever since. However, I understand that her conversion has now taken on a new form. She

believes she is pregnant and displays positive symptoms, despite her obstetrician's assurances to the contrary. Apparently, she has merely substituted one symptom constellation for another. Technically, however, the case can be closed with the terse statement, "patient cured of aphonia." She is definitely out of the realm of the laryngologist. He has been superseded by the obstetrician.

*Type Two*—M. H., a single woman aged 22, for six months was not able to speak above a whisper. She consulted a number of doctors, had her throat scraped and painted and underwent massage, tonsillectomy and manipulations—all to no avail.

The patient was surprisingly complacent about the condition of her voice. Examination revealed that she suffered from severe myopia and was so extremely sensitive about it that she unconsciously resorted to social withdrawal or flight, for which her loss of voice supplied the legitimizing sanction. She had no interest in treatment which threatened to remove her distraction and prevent her flight from a painful reality.

The painful reality was going to work. Since the work in question would call attention to her myopia, she unconsciously incapacitated herself by losing her voice. Her stage whisper legitimized her escape and at the same time was distinct enough to serve all other practical purposes.

Local manipulations had only entrenched the aphonia, because it is generally futile to remove the unconscious crutch of a neurotic patient in flight by means of direct attack. The therapeutic procedures adopted at the clinic to date have also been ineffective, and it is obvious that the patient requires further psychiatric attention.

*Type Three*—M. G., a married woman from Canada aged 49, had suffered recurrent loss of voice for the past two years.

The patient, an active business woman in her husband's department store, suddenly lost her voice on her return from a trip abroad. She took the usual numerous treatments, both in Canada and in New York, with the added feature of having several teeth extracted. She was also sent on a cruise as a therapeutic measure, but to no avail.

While away from home, seven months after losing her voice, she suddenly began to talk normally. Ten months after this recovery, on returning home from another trip, she again lost her voice. Her aphonia persisting, she came to New York for treatment, at which time she was referred to the clinic.

Analysis revealed that although the patient participated actively in her husband's business and protested that she enjoyed the work, she unconsciously rebelled against being tied down to the store and also against her husband's transference of attention to it. Her aphonia, which was precipitated on both occasions by a return to her old routine, was at once her means of escape and a means of gaining attention.

A simple explanation of the basis of her condition, which the patient readily accepted, followed by local measures in the nature of placebo, brought about desired results.

#### FALSETTO VOICE

Still another symptom complex is paraphonia, or falsetto voice. The voice of a man afflicted with this condition is thin, high, shrill and piping. It sounds forced or unnatural and, as its name implies, is a false voice—a child's voice produced by an adult.

An undeserved popular stigma is attached to the person with a falsetto voice, because this type of voice is characteristic of the eunuch and the eunuchoid (fig 1). This misunderstanding is unfortunate for the person possessing a falsetto voice, since in almost all cases the stigma of doubtful sexuality is entirely unfounded (fig 2).

The following excerpts from case histories convey clearly the marked social implications which falsetto voice has for the sufferer.

B H, aged 28 "I have had trouble with my voice being high (like a woman's) since I was 15 or 16 years old. A throat specialist told me there was nothing physically wrong with me. I have always been nervous and seem to be

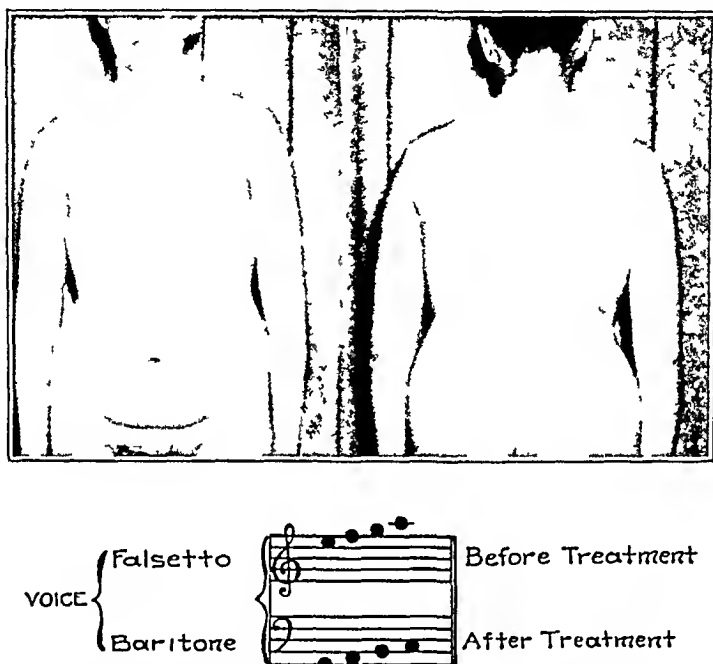


Fig 1—Boy aged 17, of eunuchoid type, with polyglandular fat anomalies and female characteristics. Range of voice before and after treatment.

more so since my voice changed. People always tease me about my voice. I am very self-conscious and avoid other people as much as possible."

A R, aged 45 "Ever since I have grown up I have felt embarrassed when in a group of men. Whenever I speak, they all laugh. I suffered untold agony when I was in the army. The other soldiers laughed at me and would make remarks in a loud whisper as I passed. I have become so sensitive about my voice that I will not even read aloud to my little daughter. Sometimes I feel I am going crazy, and I believe I should be happy just to lie down and die."

Like the other disorders, falsetto voice may usually be said to be a purely functional condition, with no pathologic involvements of the vocal organs or of the organs of generation. In its initial state, the condition can be considered as simply a neurotic manifestation of excessive sensitivity at the pubescent period.

A sensitive boy who shows neurotic tendencies and who in general is out of balance during his adolescent years is more than normally embarrassed and shocked by his general systemic changes, the change of voice included. He strives to remain on his childish level and clings to his high-pitched, shrill voice. Through constant use of this high voice, he causes a faulty coordination and misdirection of the phonatory muscles. There is an abnormal tug on the levator muscles, so that the larynx is raised to an abnormally high position in the throat.

The condition if uncorrected continues throughout the person's life, and the psychic traumas sustained by the supersensitive, neurotically inclined adult male have far reaching and serious effects.

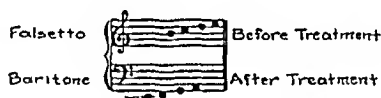
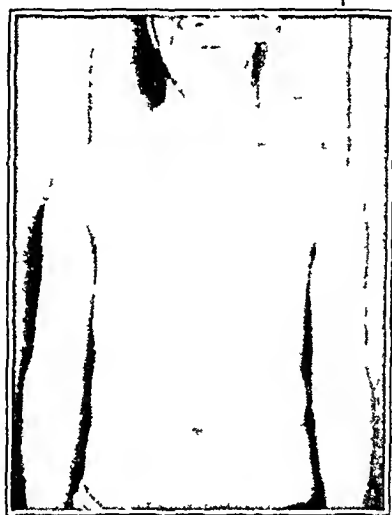


Fig 2—Man aged 33 (married, with two children), of dysplastic type (asthenicopyknic). A falsetto voice of twenty years' duration was changed to a normal male speaking voice.

#### PROGNOSIS

The main determinant of the prognosis in dealing with all these abnormalities is the degree of healthy personality which the patient presents.

In the majority of psychophonasthenic patients, the vocal disorder is so deeply ingrained psychically and the maladjustment of the personality so intertwined with environmental conditions which rarely can be changed that prognosis is none too favorable.

The circumstances which cause the onset of hysterical aphonia are situational, and the vocal manifestations are usually acute. The patients generally fall into three categories, as illustrated by the histories already given.

In type 1 the personality and the emotional reactions are on the infantile level. Aphonia proves an extremely useful mechanism, and recurrences take place as new emotional crises arise. Comprehension of the true nature of the disorder results in a cure or in conversion.

Patients of the second type unconsciously resist therapy. The disorder proves a valuable asset, and the symptom is relinquished only when it suits the patient's purpose.

The third type is represented by the person who can readily be brought to a full understanding of the unconscious motives underlying the disorder. The therapist usually can gain his confidence and cooperation, so that either the precipitating environment or the outlook on the environment is changed, making prognosis favorable.

The person with falsetto voice up to the age of puberty is a so-called normal person. His neuroticism, which develops later and which in many instances is severe, can usually be resolved when the condition of the voice is corrected. Consequently the prognosis is favorable.

#### TREATMENT

While treating these patients the therapist must realize that the person's abnormal psychologic reactions are based on a physiologic foundation, that his thoughts, feelings and actions are governed by the defects and limitations of his anatomic mechanism, that although his condition shows no evidence of organic lesion, still there exists a form of physical inferiority which influences the organism as a whole.

Therefore, a composite therapy which considers all these factors, including the development of a more integrated and mature personality, must be instituted in order to obtain desired results.

In a case of psychophonasthenia, for example, the laryngologist alone cannot administer adequate therapy. Since the basis of this disorder is on a deep level, psychiatric collaboration is most advisable. At the same time, a course of special training should be introduced to counteract vocal anomalies brought about through misuse of the larynx.

In the case of the patient with a falsetto voice, the laryngologist must have both psychiatric and musical leanings in order to bring about complete reorganization.

The same therapeutic idea applies to hysterical aphonia. Instead of using shock, which occasionally proves useful but more often detrimental, it is far better to employ a psychiatric approach in order to obtain more lasting results and thus avoid possible disaster.

In conclusion, let me emphasize the fact that it is necessary to use both local and general therapy. The presenting physical symptom—defense mechanism—must be considered as secondary and not as the principal object of treatment.

A careful anamnesis will generally uncover the underlying factors of these physical symptoms. Psychiatric measures should be directed toward bringing the patient's unconscious motives into consciousness. When this is accomplished, fundamental changes in the personality occur. The patient then accepts himself as he is, making the most of his physiologic foundation.

126 East Thirtieth Street



# INFLUENCE OF SULFANILAMIDE ON INFECTED SINUSES OF RABBITS

## CHEMICAL AND MICROSCOPIC STUDIES

BERNARD J McMAHON, M D

ST LOUIS

According to the numerous reports which have appeared in the literature during the past year, sulfanilamide (paraaminobenzenesulfonamide) therapy has continued to hold a prominent place in the successful treatment of pneumococcic,<sup>1</sup> meningococcic - and gonococcic<sup>3</sup> infections and others, of a much more remote cause, as well as those caused by hemolytic streptococci<sup>4</sup>. The fact that the immediate toxic effects have been relatively few has been an added impetus to the more extensive administration of sulfanilamide. Some toxic reactions have been easily compensated for by the withdrawal of the drug, while others, of a more serious nature, such as acute hemolytic anemia<sup>5</sup> and agranulocytosis,<sup>6</sup> are probably attributable to idiosyncrasies, according to Marshall and his co-workers<sup>7</sup>.

Many theories have been advanced to explain the mode of action of the drug. Domagk,<sup>8</sup> as the result of experiments in the treatment of experimental streptococcic infections in mice, reported that the phago-

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1 Long, P H, and Bliss, E A. South M J **30** 479 (May) 1937

2 Branham, S E, and Rosenthal, S M. Pub Health Rep **52** 685 (May 28) 1937

3 Helmholz, H F, and Osterberg, A E. Proc Staff Meet, Mayo Clin **12** 377 (June 16) 1937. Dees, J E, and Colston, J A C. Use of Sulfanilamide in Gonococcic Infections. Preliminary Report, J A M A **108** 1855 (May 29) 1937

4 Basman, J, and Perley, A M. J Pediat **11** 212 (Aug) 1937

5 Harvey, A M, and Janeway, C A. Development of Acute Hemolytic Anemia During the Administration of Sulfanilamide (Para-Aminobenzenesulfonamide), J A M A **109** 12 (July 3) 1937

6 Berg, S, and Holzman, M. Fatal Granulocytopenia Following Sulfanilamide Therapy, J A M A **110** 370 (Jan 29) 1938. Borst, J. Lancet **1** 1519 (June 26) 1937

7 Marshall, E K, Jr, Cutting, W C, and Emerson, K, Jr. The Toxicity of Sulfanilamide, J A M A **110** 252 (Jan 22) 1938

8 Domagk, G. Deutsche med Wchnschr **61** 250 (Feb 15) 1935

cytosis of the streptococci by the leukocytes was the important factor in removing the organisms from the tissues. Levaditi and Vaisman<sup>9</sup> stated that sulfanilamide interfered with the formation of capsules and thus rendered the streptococci more susceptible to phagocytosis. Colebrook and his co-workers<sup>10</sup> asserted that the serums of patients treated with certain of the derivatives of sulfanilamide were capable of inhibiting the growth of the hemolytic streptococcus *in vitro* and that the blood and serum of such patients also exerted a bactericidal as well as bacteriostatic action on the hemolytic streptococcus.

On the other hand, Gross, Cooper and Peebles<sup>11</sup> stated the belief that the phagocytic activity of the polymorphonuclear leukocytes and the monocytes is not important in controlling experimental streptococcal infections in mice. Bliss and Long<sup>12</sup> stated that the effect of sulfanilamide in experimental streptococcal infections in mice led them to believe that its action is primarily one of slowing down the rate of multiplication of the streptococci, thus permitting them to be phagocytosed by the white blood cells. They have likewise demonstrated that the leukocytes are essential if recovery from the streptococcal infection is to be expected. Osgood and Brownlee<sup>13</sup> after a series of experiments in the culturing of human marrow concluded that the major action of sulfanilamide on the beta hemolytic streptococci seems to be a neutralization of the toxins. By decreasing the rate of division of cells, while not killing the organism, sulfanilamide thus favors the more extensive phagocytic actions of the leukocytes, though it has no direct effect on phagocytosis.

It is thus obvious from these and other excellent contributions, too numerous to mention, that the trend of thought of most investigators relative to the action of sulfanilamide is inclined along similar channels. Nevertheless, the empiric status of the drug has not been changed. Marshall, Emerson and Cutting<sup>14</sup> have found that after its administration to dogs it was recovered from practically all the organs and tissues of the body. The amounts varied from 3.0 mg per hundred cubic centimeters in fat to 20.7 mg in liver, and the range of values in the

9 Levaditi, C, and Vaisman, S. *Compt rend Soc de biol* **121** 803, 1936

10 Colebrook, L, Buttle, G A H, and O'Meara, R A Q. *Lancet* **2** 1323 (Dec 5) 1936

11 Gross, P, Cooper, F B, and Peebles, M L. *Proc Soc Exper Biol & Med* **36** 311 (April) 1937

12 Bliss, E A, and Long, P H. *Observations on the Mode of Action of Sulfanilamide*, *J A M A* **109** 1524 (Nov 6) 1937

13 Osgood, E E, and Brownlee, I E. *Culture of Human Marrow. Studies on the Mode of Action of Sulfanilamide*, *J A M A* **110** 349 (Jan 29) 1938

14 Marshall, E K, Jr, Emerson, K, Jr, and Cutting, W C. *J Pharmacol & Exper Therap* **61** 196 (Oct) 1937

blood was 102 mg to 198 mg. No mention was made of its occurrence in the tissues of the nose or the sinuses.

#### PURPOSE

The purpose in undertaking the following experiments was, first, to ascertain whether or not sulfanilamide was deposited in the tissues of the noses and sinuses of rabbits in sufficiently large amounts theoretically to affect a streptococcic infection in these tissues, second, to study its effect on some tissues in which infection was not present and on some in which infection had been induced by the instillation of a virulent culture of the hemolytic streptococcus into the paranasal sinuses.

#### METHOD

Healthy rabbits, weighing between 3 and 4 pounds (13 to 18 Kg), were selected and observed for seven to ten days for freedom from infection.

*Administration of Sulfanilamide*—Sulfanilamide was administered to each rabbit on the basis of 15 Gm per kilogram (10 grains per pound)<sup>15</sup> for each twenty-four hours, the entire dose being given at the same time each day.

For the rabbits of group I the tablets were placed individually in the hypopharynx and crushed, after which several dropperfuls of water were introduced into the rabbit's mouth. To the rabbits of group II a suspension of sulfanilamide tablets ground in a mortar with 10 cc of warm water was administered through a stomach tube, followed by 5 to 10 cc of warm water to clear the tube.

*Inoculation*—All of the rabbits of group II were infected with a twenty-four hour broth culture of a virulent strain of hemolytic streptococcus, obtained from the heart blood of patients who had died of septicemia caused by infection with the hemolytic streptococcus. One-half cubic centimeter of the culture was injected through the lateral membranous window directly into the sinuses on the right side, and four to nine days were allowed to elapse in order to be certain that infection was well established in these sinuses before the administration of sulfanilamide (tables 2, 3 and 4). On the day on which the administrations of sulfanilamide were begun, 1 rabbit out of each group of 6 was killed as a control to determine the extent to which the infection of the sinus had progressed.

The daily administration of sulfanilamide was instituted for a period of one to four days in the case of 4 rabbits. At the end of this time, the 4 rabbits were killed, as was also 1 animal which had originally been infected but had not received sulfanilamide, in order to obtain an idea of the uninterrupted progress of the infection in the sinuses over the entire period of the respective series. Immediately before the rabbits which had been given sulfanilamide were killed, 10 cc of heart blood was taken, and quantitative studies were made, the modified technic of Marshall, Emerson and Cutting being followed.<sup>16</sup>

All rabbits were killed by injecting air into the heart. The nose was severed immediately anterior to the orbits and divided in midline along the septum.

15 Raiziss, G. W., Severac, M., and Moersch, J. C. *J. Chemotherapy* **14**: 1 (April) 1937.

16 Marshall, E. K., Jr., Emerson, K., Jr., and Cutting, W. C. *Proc. Soc. Exper. Biol. & Med.* **36**: 422 (April) 1937.

The right (the infected) side was placed in solution of formaldehyde, diluted 1 to 10, for twenty-four hours, decalcified, sectioned and stained with hematoxylin and eosin. The turbinates and walls of the sinus of the left side of the nose, the uninfected side, were thoroughly exenterated and weighed, this tissue was then placed in 10 cc of alcohol in a mortar and ground with a small amount of sand until thoroughly disintegrated, after which the solution was placed in a large centrifuge tube and quantitative studies made according to the technic of Marshall, Emerson and Cutting<sup>11</sup> as follows:

"After standing overnight the alcoholic tissue suspension was centrifuged, the alcohol poured off, and the tissue residue extracted four times with alcohol. The final volume of the alcoholic extract of the tissue was adjusted so that a total of 20 cc of alcohol was used for each gram of tissue. Sulfanilamide was determined in the alcoholic extract by the following modification of our original alcohol method for blood. Ten cubic centimeters of the alcoholic extract were measured into a small flask, 5 cc water, 2 cc of 0.3 N hydrochloric acid, and 1 cc of 0.1 per cent sodium nitrite were successively added. After three minutes, 1.5 cc of the alcoholic solution of dimethyl- $\alpha$ -naphthylamine (1 to 100 cc alcohol) were added. After five minutes, the solution was filtered, and the filtrate compared in a colorimeter with a standard solution of sulfanilamide in alcohol, which had been treated in the same way as the alcoholic extract."

TABLE 1—Group I Sulfanilamide Controls

Rabbit	Administration of Sulfanilamide		Elapsed Time, Days	Last Dose Before Death	Sulfanilamide Determinations*	
	Dose, Grains	Total, Grains			Blood, Mg per 100 Cc	Tissue, Mg per 100 Cc
1	35	205	19	5 days, died	0.8190	0
2	15	75	6	24 hr., killed	3.7187	27.0
3	20	110	8	48 hr., died	2.4	8.0
4	35	130	8	24 hr., died	Negative	6.0
5	35	170	15	5 hr., killed	0.5, 36.0, 42.0	27.0
6	35	165	15	5 hr., killed	1.6, 6.0, 49.0	29.0

\* The determinations of sulfanilamide were done by Miss Jane Erganian of the Washington University School of Medicine, through the courtesy of the department of medicine.

## RESULTS

The purpose of the control studies was twofold—to determine the length of time which could be permitted to elapse between doses before the blood would be found to be free of sulfanilamide and to ascertain before proceeding with the administration of sulfanilamide to the infected group whether or not there were any cytologic changes in the mucosa of the nose and paranasal sinuses caused by sulfanilamide alone in healthy uninfected rabbits. The sulfanilamide was given by mouth to the rabbits of group I in order to simulate the manner of administration in human beings, since it is known from the reports of Marshall and his co-workers<sup>17</sup> that absorption from the intestinal tract takes

17 Marshall, E. K., Jr., Emerson, K., Jr., and Cutting, W. C. Para-Aminobenzenesulfonamide. Absorption and Excretion, Method of Determination in Urine and Blood, *J. A. M. A.* **108**:953 (March 20) 1937.

place rapidly and completely. Of the 6 rabbits, 3 died, consequently the immediate antemortem determinations on the blood could not be done. The cause of death was not determined, unless it could be attributed to the repeated cardiac punctures and exsanguination, as 10 cc of blood was aspirated every few days for determinations of sulfanilamide. It was not felt that the deaths were caused by the sulfanilamide, as there were no symptoms of toxicity in these rabbits or in any in this group.

The wide variations in the amount of sulfanilamide found in the blood, as shown in table 1, were the result of two factors, the diminution of the daily dose too far below the dose prorated by weight and the permitting of more than twenty-four hours to elapse between doses. This variation in amount occurred irrespective of the total amount administered over the entire period. This is consistent with the findings of Marshall and others,<sup>17</sup> viz, that the drug is rapidly eliminated and

TABLE 2—Group II, Series 1

Rabbit	Inoculations with Hemolytic Streptococci		Administration of Sulfanilamide			Day Killed	Sulfanilamide Determinations		Toxic Signs
	No	Days	Days	Dose, Grains	Total, Grains		Blood, Mg per 100 Cc	Tissue, Mg per 100 Cc	
8	2	12	4	40	160	14th	33	23	Yes
11	2	12	4	40	160	14th	47	31	Yes
12	2	7	4	40	160	14th	27	9	No
13	3	4	2	40	80	6th	19	17	No
14*	2	2	Average				30		
15†	2	7	Average					17	

\* Rabbit 14 was killed early in the experiment as a control.

† Rabbit 15 was killed at the end of the experiment as a control.

that sustained dosage must be adhered to in order to maintain an optimum concentration in the blood of 11 to 16 mg per hundred cubic centimeters in human beings. A similar variation was found in the sulfanilamide content of the nasal tissue, the amount being found to be more or less according to the time elapsed since the last dose before death.

In the case of the rabbits of group II, the number of inoculations, the amount of the dose and the elapsed time were arbitrary. The desideratum was a well established infection of the sinuses on the right side. This was considered to be present when there occurred and persisted a definite swelling over the window of the sinus, with or without the presence of secretion in the right nostril. In several of the rabbits the sinuses were aspirated and the original organism recovered in pure culture. Because of the variation in the sulfanilamide content of the blood in group I, it was decided that the administration of a suspension of sulfanilamide with a stomach tube would be the more accurate

method A no 16 catheter was therefore passed, without difficulty into the stomach and a 10 cc syringe used to instil the proper dose, prepared as has been indicated

Since it had been found in the control group that daily dosage was necessary in order to maintain the sulfanilamide content of the blood and tissue above a certain level, the desired dose was administered to each of the rabbits of group II daily for from one to four successive days. Clinical experience had suggested that the optimum initial clinical response is obtained within ninety-six hours and consequently the cytologic response should be expected within the same length of time. It was intended not to attempt to eradicate the infection entirely, since sufficient time was not allowed, but to determine the cytologic response to the presence of the sulfanilamide in the tissues while infection was still active.

TABLE 3—Group II, Series 2

Rabbit	Inoculations with Hemolytic Streptococci		Administration of Sulfanilamide			Day Killed	Sulfanilamide Determinations		Toxic Signs
	No	Days	Days	Dose, Grains	Total, Grains		Blood, Mg per 100 Cc	Tissue, Mg per 100 Cc	
16	3	9	4	40 35 30-20	125	14th	31	17	Yes
18	3	9	1	35	35	13th	32	17	Yes
19	3	9	4	40-35 30-20	125	14th	17	14	Yes
21	3	9	4	40 35 30 20	125	14th	17	Died	No
20*	2	6	Average				24		
17†	3	9	Average					16	

\* Rabbit 20 was killed early in the experiment as a control

† Rabbit 17 was killed at the end of the experiment as a control

The dose of sulfanilamide was reduced 5 grains (0.32 Gm) a day for rabbits 16, 19 and 21, series 2, because of the toxic reactions, but maintained for series 3, despite the toxic reactions. In this group, as in group I, the total dose did not directly influence the sulfanilamide content of the blood or tissue. This is evident in the case of rabbit 18, series 2, which had received the smallest dose but showed the highest concentration of the drug in the blood and tissue that was seen in the series. Evidently a maximum initial dose supplies a comparatively large amount of sulfanilamide to the blood and tissues within twenty-four hours in certain animals. The concentration of sulfanilamide in both blood and tissue showed a wide variation, from the lowest in the blood of 17 mg per hundred cubic centimeters to the highest of 76 mg, and from the lowest in the tissue of 9 mg to the highest of 47 mg. The sulfanilamide content of the tissue ranged from 11 per cent to 67 per cent lower than that of the blood. This difference is probably explain-

able on the basis of individual susceptibilities or of a disproportion between the rate of absorption and the rate of excretion of the sulfanilamide

#### MICROSCOPIC OBSERVATIONS

*Group I Sulfanilamide Treated Control Rabbits*—The epithelium and the subepithelial tissue appeared normal. The glands showed no pathognomonic changes other than a slight distention due to hyperactivity. There was no exudate in the sinuses or the nose.

*Group II Infected Control Rabbits*—The control animals killed early in the experiment showed the usual picture of an acute hemorrhagic exudate in the nasal cavity. This exudate consisted principally of red blood cells, among which were interspersed monocytes in moderately large numbers, polymorphonuclear leukocytes in small numbers in some slides and in larger numbers in others and sloughed epithelial cells. The monocytes and the epithelial cells, especially the former,

TABLE 4—Group II, Series 3

Rabbit	Inoculations with Hemolytic Streptococci		Administration of Sulfanilamide			Day Killed	Sulfanilamide Determinations		Toxic Signs
	No.	Days	Days	Dose, Grains	Total, Grains		Blood, Mg. per 100 Cc.	Tissue, Mg. per 100 Cc.	
24	3	9	4	45	180	14th	32	18	Yes
25	3	9	4	40	160	14th	76	47	Yes
26	3	9	4	40	160	14th	71	44	Yes
27	3	9	4	40	160	14th	22	13	Yes
22*	3	9	Average				51		
23†	3	9	Average					30	

\* Rabbit 22 was killed early in the experiment as a control.

† Rabbit 23 was killed at the end of the experiment as a control.

appeared to be more actively phagocytic than the polymorphonuclear leukocytes. The control animals killed at the end of the experiment as a rule showed a marked predominance of monocytes, epithelial cells, many histiocytes containing smaller monocytes and lymphocytes but few polymorphonuclear leukocytes. Large numbers of streptococci were seen in the large monocytes only and not in the polymorphonuclear leukocytes.

*Epithelium* The epithelium varied in thickness according to the reaction, the cells being either regular in outline but engorged, with the cilia apparently intact, or greatly thickened by vacuolation, edema or protoplasmic disintegration. In other areas it showed various degrees of fragmentation, from the extrusion of individual cells into the sinus cavity to patchy or generalized sloughing of large areas, leaving in some instances an intact layer of basal cells and in others the unprotected subepithelial tissue. In the control animals killed at the end of the experiment a progression or exaggeration of the early con-

dition was seen, the intact epithelium being thickened by a reduplication of the epithelial cells, by monocytic infiltration or by extreme edema.

**Subepithelial Tissue** The most marked reaction was at the site of injection of the infective material into the sinus, extending from the immediate subepithelial tissue into the deeper tissue and consisting in some instances of edema and a moderate infiltration and in others of a marked invasion of plasma cells, monocytes, epithelioid cells, young connective tissue cells and small numbers of polymorphonuclear leukocytes. In the glandular areas the infiltration consisted chiefly of monocytes and plasma cells. The glands were uniformly greatly distended

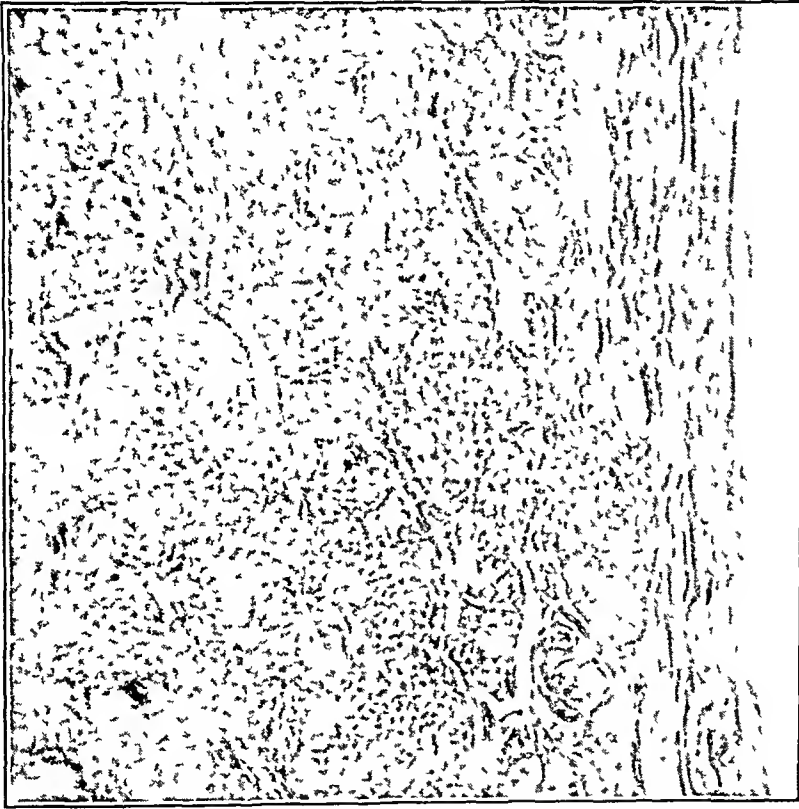


Fig 1—Typical picture found in normal and in sulfanilamide-treated control rabbits (group 1). The sinus mucosa contains low columnar ciliated epithelium. There is no cellular infiltration or disintegration of the glands of the subepithelial tissue. (High power.)

throughout and in places disintegrating. In the control animals killed later the same picture persisted, except that young and older connective tissue cells were more numerous and some lymphocytes were present. The polymorphonuclear leukocytes were practically absent.

**Group II Infected Rabbits Treated with Sulfanilamide**—The reactions in the tissue of the infected rabbits which had been given sulfanilamide were similar to those observed in the control rabbits. The behavior of the epithelium was practically identical, and the same types



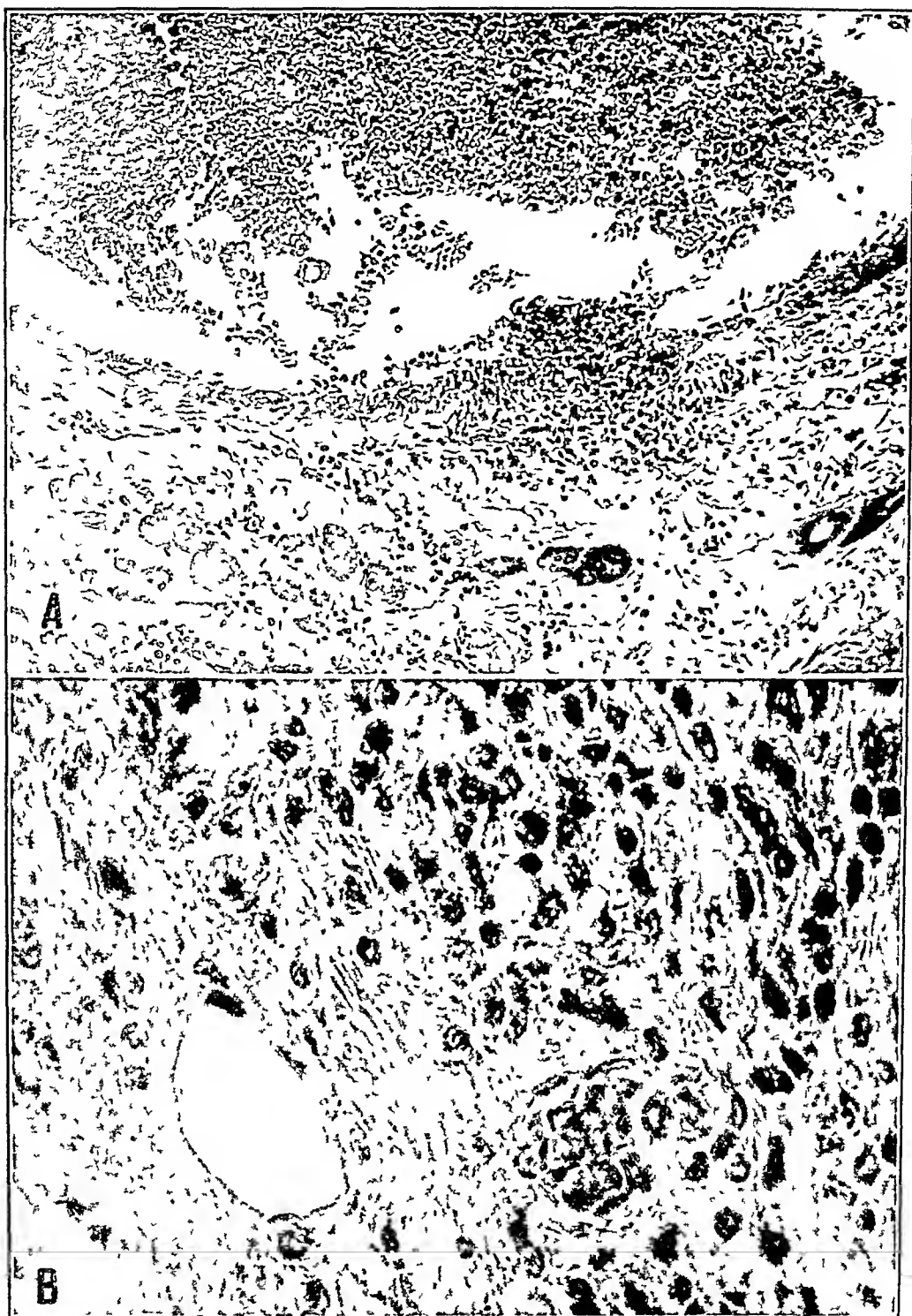


Fig 2—*A*, typical picture found in rabbits of group II. The sinus mucosa is markedly edematous and infiltrated with monocytes and plasma cells and a few polymorphonuclear leukocytes, some glands are disintegrating. The sinus cavity contains an exudate composed of red blood cells, monocytes, polymorphonuclear leukocytes and sloughed cells of the ruptured epithelium of the sinus wall, in which the exudate may be seen. (Low power) *B*, typical cytologic reaction found in all rabbits of group II. The sinus mucosa contains subepithelial tissue heavily infiltrated with monocytes, plasma cells, epithelioid cells and a few polymorphonuclear leukocytes. (High power)

and relative numbers of cells were present in the subepithelial tissue, except that there were larger numbers of free glandular cells (from ruptured glands) and of polymorphonuclear leukocytes

#### TOXIC REACTIONS

Toxic reactions were general, occurring in 9, or 75 per cent, of the 12 rabbits of group II. The following symptoms were found to be constant as to time of onset, character and duration: rapid, labored respiration, apathy, and early spastic clonus of all legs, with partial or complete paralysis of the hindlegs, in the rabbits of series 3 especially, inability to stand and spraddling of the forelegs. In some there was spasm of the abdominal muscles, with arching of the back. Vertigo also was present, manifested by weaving of the head and body and falling to one side or the other, usually toward the side on which the legs were involved, especially on attempt to overthrow. There was no nystagmus.

The onset of these symptoms occurred in from two to four hours after the administration of the sulfanilamide, and it was about six hours before all symptoms subsided. The subsidence was in the reverse order of the incidence. The amount of sulfanilamide given was undoubtedly a significant factor, since the advanced symptoms occurred on the third or fourth days of administration, though the rapid respiration was frequently present after eighteen hours. Nevertheless, 1 rabbit (no 18, group II, series 2) had received only 35 grams (2.27 Gm.) and showed toxic signs within two hours, which lasted for six and one-half hours, a circumstance strongly suggesting an idiosyncrasy, since the 3 which did not show toxic signs received three to five times as much sulfanilamide.

None of the rabbits in which toxic signs had been noted died, though 7 were killed in five hours, while the symptoms were still present but moderating. The more severe and prolonged toxic reactions were present in the rabbits showing the largest amount of sulfanilamide in the tissue, from which one may conclude that there was an equivalent amount in the tissues of the central nervous system. This fact may account for the symptoms, which were manifestations of marked irritation and probable degeneration of certain parts of the central nervous system.

#### SUMMARY

In reviewing the findings that have presented themselves in the course of this study, one is confronted with several aspects of the influence of sulfanilamide on rabbits aside from the preconceived plan of study of the cytologic changes in the tissues of the nose and sinus which result from its administration.

The fact that the absorption, the dissemination and the elimination of sulfanilamide occur with great rapidity is borne out by the variability of the amounts recovered from the blood and the nasal tissues irrespective of the total dosage. This suggests two deductions that sulfanilamide is not likely to give rise to chronic toxicosis and that its field of usefulness is limited to therapeutic, and does not include prophylactic, administration.

The frequent occurrence and the type of the toxic manifestations presented an interesting phenomenon. These toxic signs, which were more apparent in the rabbits which had been given the sulfanilamide at twenty-four hour intervals, did not fully develop until the third day, the delay indicates that there was sufficient accumulation of the drug in nerve tissue to cause the paralysis. The hyperpnea was probably due to acidosis, as described by Marshall.<sup>7</sup>

It was not possible to estimate the threshold dose which might have caused the toxic signs since the total amount administered for four days ranged from 35 to 180 grains (2.27 to 11.66 Gm.), with the sulfanilamide content of the blood from 17 to 76 mg. per hundred cubic centimeters and that of the tissue from 14 to 47 mg. This wide variation in the amount of sulfanilamide retained by the blood and tissues, even for a short time, when full doses were given strongly suggests a predilection for the drug in certain animals and probably in certain human beings. This possibility should be borne in mind in prescribing maximum doses.

After six to nineteen days' administration of moderate doses, sulfanilamide did not cause changes in the tissues of any of the uninfected rabbits, the microscopic picture of the tissues of the nose and sinus resembling in every respect that of the tissues of normal rabbits. So in the interpretation of the changes which occurred in the rabbits of group II it was certain that they were caused by infection, alone or in combination with sulfanilamide.

The cytologic reaction in the tissues of the infected control rabbits was pronounced, showing evidence of a complete mobilization of the defensive cells, viz., monocytes, plasma cells, polymorphonuclear leukocytes, young connective tissue cells and epithelioid cells, at the point of ingress of the infection and in the cavities of the sinuses and nose. There was an identical cytologic response in the rabbits which had been given sulfanilamide and in which the tissues contained large amounts of the drug. It was impossible to determine the presence of streptococci in these tissues, either extracellularly or intracellularly, consequently no criteria could be established relative to specific phagocytosis here.

The cells of the exudate in the cavities of the sinuses and nose, however, showed active phagocytosis of the streptococci. There were large

numbers of organisms present in the controls killed early in the experiment, both extracellularly and to some extent within the polymorphonuclear leukocytes, but chiefly in the monocytes. On the other hand, in the controls killed at the end of the experiment there were fewer streptococci, and those were practically entirely within the monocytes. In the rabbits treated with sulfanilamide even smaller numbers of streptococci were found. Whether this circumstance was due to the actual absence of the organisms or to their presence in unrecognizable involution forms is a matter for conjecture, as is the question whether the absence of the organisms was induced by the large amount of sulfanilamide in the tissues.

#### SUMMARY AND CONCLUSIONS

Sulfanilamide administered to 6 uninfected rabbits and to 12 whose sinuses had been injected with hemolytic streptococci was recovered in substantial amounts from the tissues of the nose and paranasal sinuses and from the blood of practically all rabbits.

The reaction to sulfanilamide in the tissues of the nose and the paranasal sinuses of these rabbits was not cytologic.

The beneficial effects derived from the use of sulfanilamide in such infections must be the result of its influence on the organism itself or on its toxins in permitting more active phagocytosis by the polymorphonuclear leukocytes and monocytes.

Sulfanilamide should be as effective in the treatment of streptococcic sinusitis as in the treatment of streptococcic infection elsewhere in the body.

The signs of sulfanilamide toxicity which occurred were hyperpnea, apathy, vertigo and spastic and flaccid paralysis.

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# FULMINATING INFECTION OF THE NOSE DUE TO MONILIA OR ASPERGILLUS

REPORT OF A CASE

C STEWART NASH, M.D.

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## HISTORY

On Aug 8, 1937, a woman aged 43 complained of a pain over her left eye. Although she admitted losing 28 pounds (12.7 Kg) in weight during the previous four or five months, she insisted that up to this time she had had no sickness and that her present trouble, namely a pain over the left eye, was unassociated with any other symptoms.

Four days later the upper left eyelid drooped and became swollen, the left eye protruded, and the vision had gone. The patient was nauseated and vomiting, had excessive thirst, frequent urination and difficult and rapid breathing and for the first time called a physician, who immediately sent her to the hospital.

Within the next forty-eight hours she had a temperature of 103 F, the eye became proptosed from a massive nonfluctuating intraorbital tumor, the left optic disk was markedly choked and soon became invisible because of an intervening exudate. A stony hardness of the globe developed from increased intra-ocular pressure, and the left side of the nose became occluded by a scabby adherent mass. The right eye remained normal.

During this same time the patient became apathetic and drowsy. There developed a questionable facial paralysis on the left but a definite and complete hemiplegia on the right. The patient remained acutely ill for two weeks, after which the fever and pain disappeared and she began to improve generally, although the left eye was completely destroyed and the hemiplegia remained.

After thirty-three days of hospitalization she was removed to another part of the state, and I did not see her again until March 2, 1938, or seven months after the onset of her symptoms.

## EXAMINATION

*Negative Findings*—The abdomen, pelvis, heart and lungs were normal, the opinion on the last organ being confirmed by roentgen examination. The blood pressure remained at about 120 systolic and 70 diastolic. The studies of the blood always gave normal results, never showing any dyscrasia, but the white blood count of 8,200 did not increase with the elevation of temperature. The hemoglobin content remained at 80 per cent. The Wassermann and Kahn tests were negative.

The anterior sinuses were definitely clear on transillumination, with the exception of the left frontal sinus, where the light was obstructed by the superficial swelling. It was noted specifically that the left antrum was clear.

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Read at the Sixtieth Annual Congress of the American Laryngological Association, Atlantic City, N. J., May 2, 1938.

*Positive Findings*—The various examinations yielded the following positive results.

1 The patient was admitted with a temperature of 97 F which rapidly rose to remain at 102 to 103 F for seven days lowering to between 99 and 100 F for the succeeding seven days and then coming down to normal for the remaining eighteen days of her hospitalization

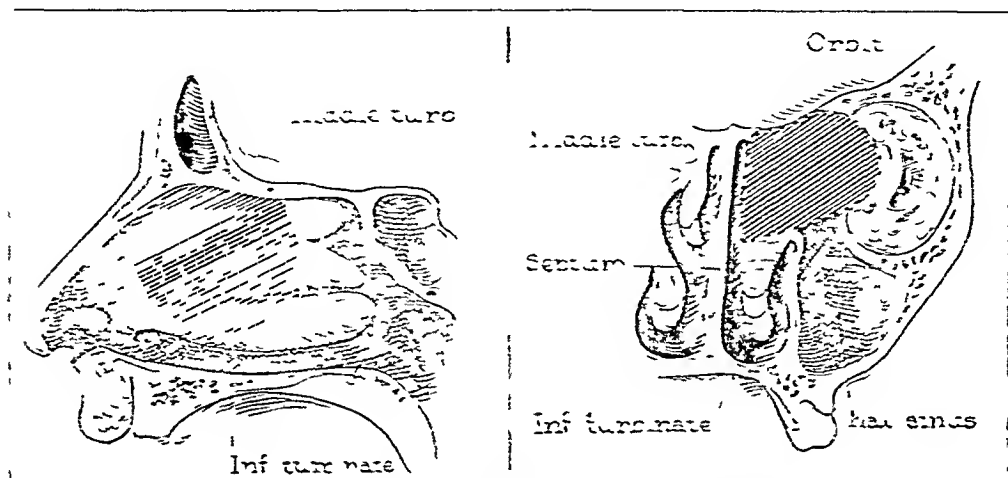


Fig 1—Sagittal and cross section of the area involved The shaded area represents the extent of the process

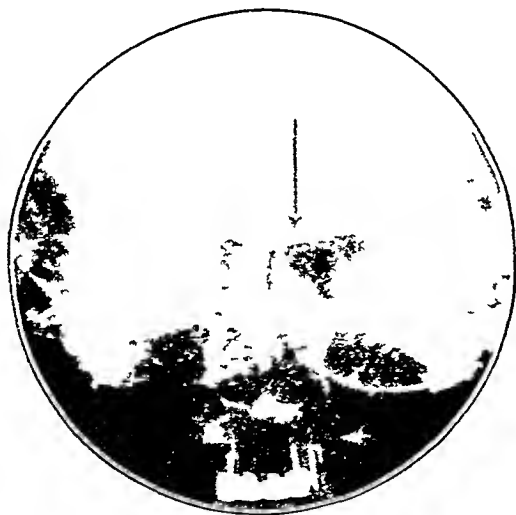


Fig 2—Area of bony absorption indicated by the arrow

2 The urine contained sugar (4 plus) acetone (4 plus) and diacetic acid (4 plus)

3 The sugar content of the blood was 298 mg per hundred cubic centimeters

4 There was present within the left side of the nose the left ethmoid sinus and the left orbit a rapidly growing necrotic tumor which within forty-eight hours showed evidence of involving the meninges and the left frontal cortex

5 On the fifth day after the onset there was a complete motor paralysis of the right side of the body

6 Biopsies were made of tissues taken from the left lateral wall of the nose and later from the intraorbital mass. The laboratory reports concerning these specimens were as follows:

A Tissue from the nose: "The specimens are formed of necrobiotic tissue, in which are some glands, areas of abundant nuclear debris and perhaps some broken-down inflammatory cells. A fairly large number of septate and branching mycelia of a fungus is infiltrating almost every part of the specimen. The fungus cannot be definitely identified, it is probably a species of *Monilia* or of *Aspergillus*. Cultural study is necessary. There is no evidence of malignancy."

B Tissue from the orbit: "The specimen is formed of necrobiotic muscle, fat tissue and a few nerve bundles. Some small areas of inflammatory reaction can be recognized. There is no evidence of malignant tumor. The fungus described in the tissue from the nose is present and is infiltrating all the tissue. It is abundant along the nerves. There is no doubt in my mind that this fungus is responsible for the necrobiotic and inflammatory swelling. Cultural study is necessary to identify the type."

7 The roentgenographic report was as follows: "There is a definite increase in density in the left ethmoid region, with blurring and loss of cellular outline, the other sinuses are clear. The density within the left orbit is increased."

#### DISCUSSION

In the light of these findings the following points are reviewed:

- 1 The patient had severe diabetes.
- 2 She had lost 28 pounds (12.7 Kg) within four months, with nothing to explain it except the diabetes.
- 3 She denied having had any illness until the onset of her present symptoms and specifically stated that she had nothing wrong with her nose, sinuses or eye.
- 4 In the case of an apparently normal person, then, only five days elapsed from the onset of her first symptom, namely, a pain over the left eye, until she had a nonsuppurative, rapidly developing, fulminating process, characterized by the formation of a necrotic mass occluding the left side of the nose, the left ethmoid sinus, the left orbit and apparently the left side of the intracranial cavity.
- 5 Within the same period of five days she had lost the left eye and complete motor paralysis of the right side of the body had developed.
- 6 Within twenty-one days all acute symptoms had subsided leaving as their sequelae a receding mass in the left side of the nose, the left ethmoid sinus and the left orbit, complete loss of the left eye and total motor paralysis of the right side.

#### TREATMENT

- 1 Insulin was given every day. Although 160 units was administered the first day, the average daily dosage was about 75 units.

2 High voltage roentgen therapy directed anteriorly at the left orbit was given in doses of 210 Behnken's units on eight different occasions during the first two weeks

3 Potassium iodide as a saturated solution was given in increasing doses for seventeen days after which a rash appeared and administration of the solution was discontinued for eight days. When it was resumed with minimum doses, another rash developed after four days, and the treatment was discontinued. The initial daily dose was 2 Gm, and the maximum, 9 Gm.

4 Of the miscellaneous forms of therapy there were administered

A Antimony and potassium tartrate, 5 cc on two occasions

B Fifty per cent solution of dextrose for reaction to insulin

C Sedatives and other symptomatic treatment



Fig 3—Paralysis of the right arm and shoulder

#### PRESENT CONDITION

Eight months after the onset, the condition of the patient is as follows

She can walk about the room but is for the most part confined to an arm chair. The left eye is collapsed, degenerated and shrunk away from the nasal wall of the orbit. There is a perforation about  $\frac{1}{2}$  inch (1.27 cm) in diameter in the anterior portion of the nasal aspect of the orbit, which communicates with the nose. This was partially occluded by a sequestrum, but there were no signs of active inflammatory process or of malignancy. Inspection of the nose revealed the same sequestrum in the left middle and inferior meatuses.

A part of this degenerated bone was removed through the orbital perforation and seemed to be a cast of the remainder of the left ethmoid labyrinth and left middle turbinate. Manipulation through the left side of the nose resulted in the removal of more sequestrum, until the whole area was clear and the underlying tissue appeared to be normal.





Fig 4—Sequestrum in situ



Fig 5—Sequestrum in situ—the eyeball degenerated and retracted from the lamina papyracea



Fig 6—Sequestrum removed

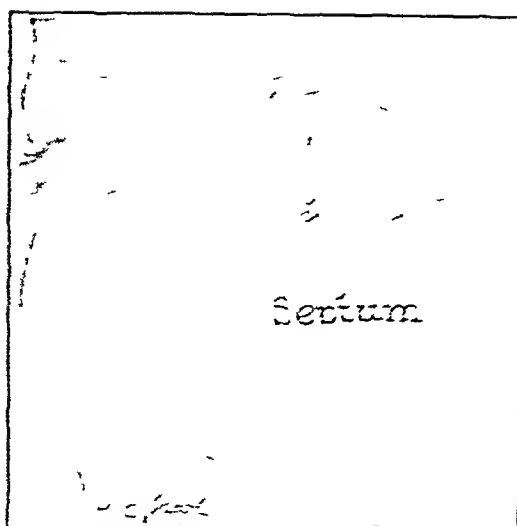


Fig 7—Pencil sketch of the patient made three weeks after the removal of the sequestrum



Fig 8—A probe inserted through the orbital perforation in the external naris



Fig 9—A probe inserted through the orbital perforation into the nasopharynx

A light was passed through the orbital perforation into the nose and inspection under strong illumination carried out

The right arm and shoulder are still completely paralyzed, and the right leg functions with a spastic gait, otherwise the muscular function on the right has returned. All reflexes on the right are increased. There are no sensory changes and no symptoms of intracranial pressure.

#### COMMENT

1 It is assumed that this condition was a fulminating infection due to *Monilia* or *Aspergillus* because the original bacteriologic studies showed an abundance of typical microscopic forms and nothing else to account for the condition. On the other hand, reculture of this material on regular and special mediums showed no growth, consequently this assumption is not verified.

2 It is not known what was the exciting cause or what part the diabetes played.

3 It is not known why the process was arrested. Certainly the treatment was empiric.

4 It is not known what happened intracranially, but the supposition is that there was a localized lesion in the meninges and the posterior aspect of the frontal lobe. In any case, the left motor area was involved whereas the adjacent sensory and speech areas were not involved.

5 The prognosis so far has shifted three times.

A During the acute stage the condition was considered hopeless.

B During the convalescence from the acute stage the prospect for recovery from the acute condition was considered fair, but recurrence was thought possible. The left eye was destroyed, and there was complete hemiplegia on the right.

C At the present time the possibility of a recurrence of the acute condition seems doubtful. There is permanent loss of the left eye. In spite of the lack of demonstrable motor function in the right arm and shoulder, it seems possible that all motor function may return.

# RECOVERY OF A PATIENT WITH TYPE III PNEUMOCOCCUS MENINGITIS OF OTITIC ORIGIN

JULIUS GUBNER, M D

BROOKLYN

Type III pneumococcus meningitis is a disease so uniformly fatal that it appears of particular interest to report a complete recovery

B B, a boy aged 5½ years, was first admitted to the hospital on Oct 9, 1937. The mother stated that two weeks previously the child had complained of pain in the right ear, for which ear drops were given and the child put to bed. The pain subsided in three days, and the patient was well thereafter until three days before his admission, when he again complained of pain in the right ear. The pain was accompanied by malaise. The temperature was 103 F. Tenderness and swelling were present behind the right ear.

On admission there was tenderness over the right mastoid, which was more marked over the zygomatic region. There was postauricular swelling, with displacement of the auricle and sagging of the superoposterior canal wall. There was a mucopurulent discharge from the external auditory canal. The temperature was 103.6 F. The leukocyte count was 19,000, with 90 per cent of polymorphonuclear cells. The urine was normal.

Immediate mastoidectomy was advised. It was performed the same afternoon. A postauricular incision was made extending down to the periosteum. As soon as the periosteum over the antrum was elevated, a great deal of pus welled up through a perforated cortex. The lesion in the cortex extended forward toward the zygoma. The cells were filled with pus, but the intercellular structure was not destroyed. The tegmen antri was soft, and was removed. The dura was normal in appearance. Culture of pus from the mastoid yielded *Pneumococcus* type III.

The postoperative course was uneventful. Four days after the operation the sutures were removed, the mastoid wound was clean. From October 14 the patient was afebrile, and he was discharged apparently well on October 19, ten days after admission.

The day after his discharge the child had a frontal and occipital headache and vomited. The next day (October 21) he appeared comfortable and did not complain, although he had a congested pharynx, subacute tonsillitis and an inflammation of the left ear. Two days later the mastoid wound was dressed and was found to be clean. On October 24 he again complained of severe frontal headache, and finally, on October 25, he was readmitted to the hospital acutely ill. The temperature was 102.4, and he complained of severe frontal headache.

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From the Oto-Laryngologic Service of the Israel-Zion Hospital, Samuel J. Kopetzky, M D, director.

The careful laboratory studies were performed under the direction of Dr. L. Rosenthal, director of laboratories at the Israel-Zion Hospital.

Examination disclosed slight puffiness over the zygoma, the mastoid wound being clean. The neck was slightly rigid, and there was a questionable Kernig sign. The deep reflexes were hyperactive, the abdominal and the cremasteric reflexes were present. The Babinski sign was absent. The examination otherwise gave negative results. The eyegrounds were normal.

Roentgenograms of the petrous pyramid taken the day of admission were unsatisfactory. Roentgenograms of the mastoid taken the next day were interpreted as follows: "The left mastoid shows no evidence of pathologic change. On the right, most of the cells are absent, although there are a few cells in the posterior region of the body and the area of the tips. There is no evidence of any breaking through of the tegmen. The wall of the sinus is clearly demarcated."

Spinal tap, performed the same day, yielded cloudy fluid under increased pressure (32 mm of mercury), 20 cc being withdrawn. Daily lumbar punctures were performed thereafter, from 15 to 25 cc being removed. The spinal fluid findings, as well as other laboratory data, including temperature and total and differential leukocyte counts throughout the clinical course, are presented in the table. Cultures of the spinal fluid yielded *Pneumococcus* type III on three occasions (October 30, November 7, November 30).

Sulfanilamide therapy was instituted on October 25, doses of 40 grains (2.6 Gm) being given daily. Frequent small transfusions were given, as indicated in the table, totaling 510 cc in three weeks.

Surgical exploration was contemplated, but it was not carried out immediately, because of a seeming improvement obtained by spinal tap and administration of sulfanilamide.

Clinically the patient appeared comfortable during the first few days, the only new development being the appearance of a morbilliform rash over the chest and shoulders on October 28, possibly due to sulfanilamide, although sulfanilamide rash most often occurs about ten days after administration of the drug.

In view, however, of the persistence of meningeal signs and an increase in the cell count of the spinal fluid, it was decided to explore the mastoid wound. On November 2 the old wound was reopened and was enlarged over the zygoma, in which a few cells containing granulations were found. The zygoma was entirely exenterated. The inner table over the temporosphenoid lobe, the cerebellum and the lateral sinus was removed. This was very soft and necrotic in spots, no bone being preserved except that of the petrous pyramid and the labyrinth. The operative diagnosis was probable osteomyelitis of the inner table of the mastoid. No histologic examination, however, was made.

After the operation the patient improved rapidly. By November 6 the spinal fluid was found to be clear, and it remained intermittently clear thereafter. The patient improved clinically, and he was afebrile after November 18, rigidity of the neck and the Kernig sign also disappearing about this time. The operative wound healed uneventfully, and the patient was discharged, apparently entirely well, on December 2.

#### COMMENT

It is fortunate indeed that pneumococcic meningitis is an infrequent disease, for results of treatment heretofore have been most discouraging. In a study of 468 cases observed during a ten year period in the state charity hospital of Louisiana, Tripoli<sup>1</sup> reported an incidence

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1 Tripoli, C J. Bacterial Meningitis. A Comparative Study of Various Therapeutic Measures, *J A M A* 106 171 (Jan 18) 1936.

*Clinical and Laboratory Data in a Case of Type III Pneumococcus Meningitis with Recovery*

Date	Apparent Pres- sure	Spleen fluid			Globe ultra	Culture	Temperature		White Blood Count			Meth- uen stain, per 100 (c)	Sulfon amide, mg per 100 (c)	Sulfon amide dose, grams, q	Trans- fu- sion, q
		Cells, per cu mm	Poly- morpho nuclears	Sugar	Albumin		High	Low	Total	Poly- morpho nuclears, %	Immune type, %				
10/25/17	Cloudy 15 Hg	1,100	100	1	0	±	Neg.	100.5	90,600	00				10	
10/25/17	Cloudy	100	51	1	0	1	Neg.	99.6	1,050	01	6			10	
10/27/17	Cloudy	500	95	1	0	1	Neg.	100.0						10	60
10/28/17	Cloudy	100	85	1	0	1	Neg.	101.1	0,600	09	10	1.5		10	60
10/29/17	Cloudy	1,050	100	1	1	1	Neg.	100.0						10	60
10/30/17	Cloudy	1,100	100	1	1	1	Pneumo	99.9	8,000	11	11			10	
10/31/17	Cloudy	0,100	100	1	0	1	cocci type 1		15,000	11	9			10	
11/1/17	Cloudy	500	80	1	1	1	Neg.	101.1	11,600	15	15	0.1		10	60
11/2/17	Cloudy	1,000	95	1	1	1	Neg.	100.5	13,000	07	19			10	
11/3/17	Cloudy	1,100	95	1	1	1	cocci type 1							10	
11/4/17	Slightly cloudy	1,050	85	1	1	1	Neg.	100.0						10	60
11/5/17	Slightly cloudy	550	02	1	1	1	Neg.	103.1				0.1		10	
11/6/17	Almost clear	60	70	1	1	1	Neg.	100.0	10,100	07	11			10	60
11/7/17	Clear	70	01	1	1	1	cocci type 3							10	
11/8/17	Clear	0,100	05	0	1	1	Neg.	100.0						10	
11/9/17	Clear	1,100	95	1	0	1	Neg.	101.0	13,000	13		0.1		10	60
11/10/17	Slightly cloudy	900	90	1	1	1	Neg.	101.0	10,000	05				10	
11/11/17	Slightly cloudy	900	100	1	1	1	Neg.	100.1				0.6	5.58	10	900
11/12/17	Clear	970	85	1	1	0	Neg.	100.0	7,000	57				10	
11/13/17	Cloudy	150	00	1	1	0	Neg.	101.0	11,000	59				10	
11/14/17	Clear	900	100	1	1	1	Neg.	100.0						10	
11/15/17	Cloudy	50	50	1	1	1	Neg.	100.5	10,000	71	13	0.7	8.19	50	
11/16/17	Clear						100.0	101.1	7,000	60	11			60	
11/17/17	Clear						99.0	99.6	5,000	50	9			60	
11/18/17							99.0	99.6	10,100			0.1	10.11	60	
11/19/17							99.5	99.5	10,100					60*	

\* Further course. Afebrile to discharge. White blood count, 11/20, 7,000, 95 per cent polymorphonuclears, 10 immature forms; 11/22, 5,800, 11 per cent polymorphonuclears, 10 immature forms; 11/24, 0.4 cm; 11/26, 0.1 cm; 11/28, 0.1 cm; 11/30, 0.1 cm. Concentration of sulfamamide 11/30, 0.5 mg per hundred cubic centimeters; 11/31, 0.9 mg per hundred cubic centimeters; Sulfamamide dose 60 tablets daily to 11/31, 90 tablets daily thereafter to discharge.

of 111, or 23.7 per cent, of cases of pneumococcic meningitis, in 8 of which the organism was *Pneumococcus* type III. In these 111 cases there was only 1 recovery, the condition in this case not being due to the type III pneumococcus. Neal<sup>2</sup> found 66 cases of pneumococcic meningitis in a series of 1,259 cases of meningitis. In 8 of these the disease was due to *Pneumococcus* type III. Of the last 100 cases of meningitis reported to the New York city department of health, 22 were cases of pneumococcic meningitis, the mortality was 100 per cent. Neal<sup>3</sup> informed me that in her extensive experience she has seen no recoveries from type III pneumococcus meningitis.

#### OTITIC ORIGIN OF PNEUMOCOCCIC MENINGITIS

In a recent comprehensive study, Neal<sup>4</sup> and her colleagues found that in 75, or 35 per cent of 214 cases of pneumococcic meningitis the condition was of otitic origin or arose in the paranasal sinuses. "Type III was most commonly found in meningitis secondary to otitis media, mastoiditis and sinusitis." In 35, or 75 per cent of 47 cases of type III pneumococcus meningitis the condition was of otitic origin or arose in the paranasal sinuses, cases of type III pneumococcus meningitis comprising 55 per cent of all cases of meningitis of otitic or sinus origin.

Williams,<sup>5</sup> analyzing 597 cases of meningitis in which the condition was due neither to meningococci nor to tubercle bacilli, emphasized the otitic background, concluding that "the great majority of these cases occur after middle ear and sinus infections."

#### PREVENTION OF TYPE III PNEUMOCOCCUS MENINGITIS

The gravity of meningeal infection due to the type III pneumococcus, once established, has led quite properly to an attempt at prophylaxis by more adequate treatment of the antecedent otitis. Shambaugh<sup>6</sup> urged energetic surgical attack on the infected mastoid when beginning meningitis is suspected, recommending thorough drain-

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2 Neal, J, in Tice, F. Practice of Medicine, Hagerstown, Md, W. F. Prior Company, Inc, 1920, vol. 10, chap. 15, p. 255, cited by Goldstein, H. I., and Goldstein, H. Z. *Pneumococcus Meningitis and Endocarditis*, Internat. Clin. 3: 155 (Sept.) 1927.

3 Neal, J. Personal communication to the author.

4 Neal, J., Jackson, H. W., and Applebaum, E. A Comprehensive Study of Meningitis Secondary to Otitic or Sinus Infection, *Ann. Otol., Rhin. & Laryng.* 43: 658 (Sept.) 1934.

5 Williams, A. W. Bacteriology of Meningitis Following Otitis Media and Related Infections, *Ann. Otol., Rhin. & Laryng.* 43: 667 (Sept.) 1934.

6 Shambaugh, G. E., Jr. The Surgical Treatment of Meningitis of Otitic and Nasal Origin, *J. A. M. A.* 108: 696 (Feb. 27) 1937.

age and wide exposure of the dura over the tegmen of the middle ear and mastoid Kopetzky<sup>7</sup> likewise recommended "Where in an otogenic lesion meningeal involvement is surmised, the surgical removal of the entire visceral side of the temporal bone is indicated as far as that is surgically possible"

The frequent inadequacy of surgical procedures alone in the treatment of type III pneumococcus otitis has stimulated an attempt to increase the resistance of the host by active immunization Goldman and Herschberger,<sup>8</sup> using autogenous type III pneumococcus vaccine, reduced the incidence of intracranial complications and thereby the mortality of acute mastoiditis due to *Pneumococcus* type III from 32.5 per cent to less than 10 per cent

#### REPORTED RECOVERIES FROM PNEUMOCOCCIC MENINGITIS

The lesion established, neither surgical treatment nor immunization is of any considerable avail Mortality for all types of pneumococcic meningitis is extremely high, in some large series up to 100 per cent Otitic pneumococcic meningitis is of particular severity Kolmer<sup>9</sup> in 1926 reviewed his experiences over a seven year period with 41 cases of pneumococcic meningitis of otitic or nasal origin, in all of which the patients died

Goldstein and Goldstein,<sup>10</sup> reviewing the literature to 1927, estimated that there are on record about 150 recoveries from proved pneumococcic meningitis Reveno and McLaughlin<sup>11</sup> listed 15 additional recoveries, including 1 in a case of their own, reported by various authors from 1927 to 1934 Mertins and Mertins,<sup>12</sup> in a recent survey of the literature for the past fifteen years, found reports of 30 recoveries from pneumococcic meningitis

Recovery has been attributed to various measures, no one of which, however, has been successful except in isolated instances These measures include

7 Kopetzky, S J Newer Concepts of Otogenic Meningitis, *Laryngoscope* **45** 827 (Nov) 1935

8 Goldman, J L, and Herschberger, C Vaccination Against Intracranial Complications Following Mastoiditis, *J A M A* **109** 1254 (Oct 16) 1937

9 Kolmer, J A Chemotherapy and Serum Therapy of *Pneumococcus* and *Streptococcus* Meningitis, *Arch Otolaryng* **3** 481 (June) 1926

10 Goldstein, H I, and Goldstein, H Z Pneumococcal Meningitis and Endocarditis, *Internat Clin* **3** 155 (Sept) 1927

11 Reveno, W S, and McLaughlin, N *Pneumococcus* Meningitis Recovery with Felton's Serum, *Ann Int Med* **7** 1027 (Feb) 1934

12 Mertins, P S, and Mertins, P S, Jr Meningitis Due to the Type IV *Pneumococcus* with Recovery, *Arch Otolaryng* **25** 657 (June) 1937



1 Forced spinal and cisternal drainage (Globus and Kasanin,<sup>13</sup> Bedell,<sup>14</sup> Meyer<sup>15</sup>)

2 Use of homologous pneumococcus antiserum (Williams,<sup>5</sup> Reveno and McLaughlin,<sup>11</sup> Harkavy<sup>16</sup>)

3 Use of nonspecific serum, antipneumococcus and antimeningococcus (Cavenagh,<sup>17</sup> Steinholz and Gleich<sup>18</sup>)

4 Administration of ethylhydrocupreine hydrochloride U S P (Ratnoff and Litvak<sup>19</sup>)

5 Use of various antiseptics intraspinally—methenamine (Roussel,<sup>20</sup> Bratesco and Moga,<sup>21</sup> mercurochrome (McAskill<sup>22</sup>) and acriflavine hydrochloride (Fleischmann<sup>23</sup>)

6 Nott's treatment with enemas of potassium permanganate solution (Weinberg<sup>24</sup>)

Spontaneous recovery has been reported (Ravenel<sup>25</sup>)

That these measures are most often ineffectual is shown by Kolmer and Idzumi,<sup>6</sup> who treated 11 patients with intraspinal injections of ethylhydrocupreine hydrochloride U S P alone or in combination

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13 Globus, J H, and Kasanin, J I Pneumococcic (Type IV) Meningitis, J A M A **90** 599 (Feb 25) 1928

14 Bedell, C C Pneumococcic Meningitis Report of a Case with Recovery Following Cisternal Drainage, J A M A **102** 820 (March 17) 1935

15 Meyer, P R Pneumococcic Meningitis Report of a Case with Recovery Following Cisternal Drainage, J A M A **105** 1844 (Dec 7) 1935

16 Harkavy, J Pneumococcic Meningitis Recovery with Serum Therapy, J A M A **90** 597 (Feb 25) 1928

17 Cavenagh, J B Recovery from Pneumococcal Meningitis, J Laryng & Otol **48** 337 (May) 1933

18 Steinholz, R, and Gleich, M Pneumococcus (Type III) Meningitis Recovery, J A M A **105** 795 (Sept 7) 1935

19 Ratnoff, H L, and Litvak, A M Pneumococcus Meningitis Treated with Morgenroth's Optochin Hydrochloride Report of a Case with Recovery, Arch Pediat **43** 466 (July) 1926

20 Roussel, A E Pneumococcal Meningitis Simulating Diabetic Coma with Recovery, Atlantic M J **30** 159 (Dec) 1926

21 Bratesco, V, and Moga, N Oto-mastoidite aigue pneumococcique gauche avec meningite pneumococcique, operation, guerison, Ann d'oto-laryng, June 1936, p 574

22 McAskill, J E Treatment of Purulent Leptomeningitis Secondary to Otitis Media, Ann Otol, Rhin & Laryng **35** 502 (June) 1926

23 Fleischmann, O Zur Frage der Sero- und Chemotherapie der otogenen und rhinogenen Meningitis, Klin Wchnschr **1** 217 (Jan 28) 1922

24 Weinberg, M H Case of Pneumococcus (Type III) Meningitis Treated with Potassium Permanganate, Recovery, J Nerv & Ment Dis **74** 38, 1931

25 Ravenel, S F Spontaneous Recovery from Pneumococcal Meningitis Report of a Case in a Newborn Infant, South M J **29** 86 (Jan) 1936

26 Kolmer, J A, and Idzumi, G Chemotherapeutic Studies with Ethylhydrocuprein and Mercurophen in Experimental Pneumococcus Meningitis in Rabbits, J Infect Dis **26** 355 (April) 1920

with homologous antiserum, without a single recovery Musser<sup>27</sup> reported 18 cases of pneumococcic meningitis in which the condition was treated by combined cisternal and lumbar puncture, lavage and injection of serum, all of which terminated fatally Tripoli<sup>1</sup> likewise had no success with any of these measures, only 1 recovery occurring in 111 cases of pneumococcic meningitis

Tripoli,<sup>1</sup> Musser<sup>27a</sup> and Neal<sup>27b</sup> have all warned of the dangers of indiscriminate use of heroic measures, such as intrathecal medication with various chemicals and cisternal drainage Tripoli reported that several deaths occurred so quickly after intraspinal administration of a chemical agent, such as ethylhydriocupreine hydrochloride U S P or one of various antiseptics, that this practice was discontinued Musser and Neal emphasized the danger of cisternal tap, Neal citing from 25 to 30 deaths caused by cisternal puncture Neal and her colleagues<sup>4</sup> stated

the most important therapeutic factor, aside from the removal of the primary foci of infection, is adequate drainage of the cerebrospinal fluid Unless there is blocking, this can be accomplished by lumbar puncture There is no evidence that the more radical forms of drainage are more effective A greater number of recoveries has followed ordinary spinal drainage than any other form of treatment

#### RECOVERY FROM TYPE III PNEUMOCOCCUS MENINGITIS

Of all the types of pneumococcic meningitis, that caused by *Pneumococcus* type III is the most severe Its severity is probably due both to the greater pathogenicity of the organism and to the fact that the disease is most often of otitic origin, otogenous meningitis in general offering a particularly poor prognosis Furthermore, specific antiserum has not proved as effectual against type III pneumococci as it has against other types, such as type I

In all, there have been reported only 5 recoveries from this type of pneumococcic meningitis Allman<sup>28</sup> recently reported a recovery and found 4 other cases in reviewing the literature In his case meningitis occurred after radical mastoidectomy and labyrinthectomy for cholesteatoma with long-standing otitis and labyrinthitis Allman stated that the organism in his case, and probably in the case of other reported recoveries, was of low virulence In the case reported by Steinholtz and Gleich<sup>18</sup> meningitis occurred in the course of post-traumatic subacute purulent otitis media The meningitis was mild, the cell count of the

27 Musser, J H Treatment of Acute Infectious and Contagious Diseases, J A M A 88 1125 (April 9) 1927

27a Musser, J H in discussion on Tripoli<sup>1</sup>

27b Neal, J B, in discussion on Tripoli<sup>1</sup>

28 Allman, C H Meningitis Due to the Type III *Pneumococcus*, Arch. Otolaryng 25 653 (June) 1937

spinal fluid reaching only 200 per cubic millimeter. The organism was of greatly attenuated virulence, since mice into which specimens of spinal fluid from the patient were injected did not die.

In these cases, then, recovery is to be ascribed to the low virulence of the organism and to an increased resistance of the host established in the course of a long-predciding otitis. Kopetzky<sup>7</sup> remarked

The very poorest results from meningitis are found in those cases in which mastoidectomy was necessary during the first week of the middle ear infection. Obviously the stormy and alarming clinical picture makes necessary the early mastoidectomy, and the stormy clinical picture heralds the advent of the meningitis. The mastoidectomy per se seems not to inhibit the development of a meningeal lesion. Cases which occur as sequelae of middle ear chronicities are again to be comprehended as of a different origin and different nature.

The case reported here falls in the first of these categories, the meningitis following rapidly on acute mastoiditis for which simple mastoidectomy had been performed.

In view, therefore, of the severe nature of the meningitis in this case, it is of interest to inquire into the measures which may have contributed to the cure. These included a daily lumbar tap with drainage to relieve pressure, a procedure recommended by Neal, as has been noted. Small blood transfusions were given, as advocated by Kopetzky, and complete eradication of the possible focus was performed. In addition, sulfanilamide therapy was employed.

#### USE OF SULFANILAMIDE FOR PNEUMOCOCCIC INFECTIONS

Rosenthal<sup>29</sup> found sulfanilamide a potent therapeutic agent in the treatment of experimental pneumococcic infection with virulent strains in mice, in rabbits and particularly in rats. The curative action was most evident with type III pneumococcus infections. Rosenthal concluded that "up to the present time no other compounds have been found as effective against pneumococcic infections as sulfanilamide."

Gross and Cooper<sup>30</sup> also obtained favorable results with sulfanilamide in treating type III pneumococcus infections in rats.

Long and Bliss<sup>31</sup> reported

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29 Rosenthal, S. M. Studies in Chemotherapy. Chemotherapy of Experimental Pneumococcus Infections, Pub Health Rep **52** 48 (Jan 8) 1937. Rosenthal, S. M., Bauer, H., and Branham, S. E. Comparative Studies of Sulphanilamide Compounds in Experimental Pneumococcus, Streptococcus and Meningococcus Infections, Pub Health Rep **52** 662 (May 21) 1937.

30 Gross, P., and Cooper, F. B. Efficacy of *p*-Aminobenzenesulfonamide in the Experimental Type III Pneumococcus Pneumonia of Rats, Proc Soc Exper Biol & Med **36** 225 (March) 1937.

31 Long, P. H., and Bliss, E. A. The Use of Para-Aminobenzene-Sulphanilamide (Sulphanilamide) or Its Derivatives in the Treatment of Infections Due to Beta Hemolytic Streptococci, Pneumococci and Meningococci, South M J **30** 479 (May) 1937.

Our experience in the treatment of clinical pneumococcal infections in human beings has been primarily limited to those of the middle ear and mastoid. Our observations tend to show that sulfanilamide has about one half the chemotherapeutic effect in pneumococcal infections that it has in hemolytic streptococcal infections of the middle ear and mastoid.

Mertins and Meitins<sup>32</sup> recently reported a case of unclassified type IV pneumococcus meningitis of otitic origin in which the patient recovered after sulfanilamide therapy.

The mode of action of sulfanilamide is still mooted. Rosenthal<sup>32</sup> stated

The bacteriologic and bactericidal action of sulphonamide on pneumococci in vitro is adequate to explain its chemotherapeutic effect in animals. The nature of this action in vitro is unusual in that the drug is not an antiseptic in the usual sense.

Long and Bliss, however, remarked

We can only conclude that a change takes place in the organism which renders them susceptible to phagocytosis, but the nature of this change is still unknown. Certainly we have no evidence that the bacteriostasis observed in vitro plays an important role in vivo. It is important to note, however, that the change brought about by the sulfanilamide therapy is not instantaneous, but requires a period of several hours before it begins to develop. This suggests the possibility of a union between the organism and chemical by which a marked change in the metabolism of the streptococcus is brought about. We believe that sulfanilamide exerts its action upon the streptococci rather than upon the leucocytes.

Branham and Rosenthal<sup>33</sup> found that the curative effect of sulfanilamide or of homologous antiserum alone on experimental pneumococci infection in mice is greatly enhanced by the combined use of serum and sulfanilamide.

Long and Bliss<sup>31</sup> have emphasized the importance of adequate dosage checked by estimation of the concentration of sulfanilamide in the blood, a level of from 8 to 10 mg per hundred cubic centimeters being desirable for full therapeutic effect. The dose of from 40 to 60 grains (2.6 to 3.9 Gm.) daily used in this case accords with Long and Bliss's recommended dose for children weighing from 25 to 50 pounds (11.3 to 22.7 Kg.). Sulfanilamide determinations by the method of Marshall<sup>34</sup> showed concentrations of 5.88, 10.14, 9.5 and 9.22 mg per

32 Rosenthal, S. M. The Effect of p-Aminobenzine Sulphonamide on Pneumococci in Vitro, Pub. Health Rep. 52 192 (Feb. 12) 1937.

33 Branham, S. E., and Rosenthal, S. M. Sulphanilamide, Serum and Combined Drug and Serum Therapy in Experimental Meningococcus and Pneumococcus Infections in Mice, Pub. Health Rep. 52 685 (May 28) 1937.

34 Marshall, E. K., Jr., Emerson, K., and Cutting, W. C. Para-Aminobenzenesulfonamide. Absorption and Excretion, Method of Determination in Urine and Blood, J. A. M. A. 108 953 (March 20) 1937.

hundred cubic centimeters of blood. Values for the spinal fluid were of a similar range, the concentrations on two occasions being 8.18 and 4.18 mg per hundred cubic centimeters. Marshall and his colleagues<sup>34</sup> showed that sulfanilamide is absorbed completely from the gastrointestinal tract in four hours and is found in the spinal fluid (as well as in other body fluids) in only slightly lower concentrations than in the blood within a few hours of administration. They suggested, therefore, that the drug be given orally when its presence in the cerebrospinal fluid is desired.

#### USE OF BLOOD TRANSFUSIONS

Sulfanilamide has occasionally been indicated<sup>35</sup> for its deleterious effect on hemoglobin. Frequent estimations of total hemoglobin content and methemoglobin content were therefore made throughout the course of the illness. The highest levels of methemoglobin were found in the first week of illness, namely, 1.7 and 1.1 Gm per hundred cubic centimeters of blood. Later estimations varied from 0.2 to 0.7 Gm.

The total hemoglobin content, initially 14 Gm, fell during the course of the meningitis to 9 or 10 Gm, and frequent transfusions of whole blood were given to maintain the hemoglobin level, a total of 510 cc in seven doses being given during a three week period.

Kopetzky<sup>7</sup> has indicated that transfusion may be of direct value in the treatment of purulent meningitis. In studying the effect of the transfusion on the chemistry of the cerebrospinal fluid, he found

the transfusions seemed to bring the  $pH$  toward the normal, increase the chlorides and carbonates and markedly lessen the lactic acid content of the fluid. In other words, there seems to be a trend toward the normal chemical content produced in the pathologic fluid by transfusion of whole blood.

#### CONCLUSIONS

When the presence of otitic meningitis is suspected, it becomes of prime importance that every possible focus in the component parts of the temporal bone be first surgically removed. It is almost impossible to localize these foci macroscopically, therefore, the removal of probably diseased areas should be made as far and as wide as possible. Thereafter the use of chemotherapy and the giving of support to the tissues by transfusion are in order. Regarding chemotherapy, sulfanilamide appears to be a valuable agent in the treatment of type III pneumococcus meningitis. Oral administration is satisfactory, as sulfanilamide is distributed almost evenly through all body fluids, including the spinal fluid. Adequate doses are necessary for full therapeutic effect and should be given with the object of main-

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<sup>35</sup> Kohn, S. E. Anemia During Treatment with Sulfanilamide, *J. A. M. A.* 109:1005 (Sept. 25) 1937.

taining a concentration level in the blood of from 8 to 10 mg per hundred cubic centimeters

Since type III pneumococcus meningitis is most frequently of otitic or sinusal origin, the most promising approach is to be sought in prophylaxis by adequate surgical treatment fortified by injection of type III pneumococcus vaccine, as recommended by Goldman

Once the lesion is established, sulfanilamide therapy appears to offer the greatest specific benefit. It should be supplemented by daily spinal drainage to relieve pressure and by frequent small blood transfusions. Type III pneumococcus antiserum may also be of some value, and there is evidence that the effects of sulfanilamide and serum are additive.

# Progress in Otolaryngology

## Summaries of the Bibliographic Material Available in the Field of Otolaryngology

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### THE PARANASAL SINUSES

SAMUEL SALINGER, M D

CHICAGO

The otolaryngologic literature for 1937 still manifests a trend toward conservatism in treatment. Operations on the sinuses are becoming more standardized, and there are fewer variations of the well known procedures. Operative failures are being brought into the open for discussion, and as a result one may expect a clearer conception of the indications and limitations of the various operations.

There have been more reports on osteomyelitis than in former years, and the subject of fractures involving the sinuses is thoroughly discussed in several interesting articles. Interest in the latter will doubtless increase because of the large numbers of automobile accidents.

#### ANATOMY-EMBRYOLOGY

Honda<sup>1</sup> has written three papers on the anatomic structure, the histologic appearance and the embryologic development of the sinuses, his studies being based on serial sections of 52 Japanese embryos ranging from 7 to 40 weeks in age. While most of the facts disclosed have long been known, some points are brought out which should be of general interest. Honda finds that the epithelium of the meatuses which begins forming in the eighth week is already arranging itself in layers and increasing in height. In the eleventh week sub-epithelial capillaries are seen in the respiratory region which are the beginning of the formation of "swell bodies." In the twelfth week the capillaries in the mesenchyme in the vicinity of the perichondrium are distinct, as are those about the developing periosteum. Cilia appear on the epithelial cells of the rudimentary maxillary sinus in the fourteenth week. The epithelium differentiates into layers about the

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1 Honda, T. Entwicklungsgeschichtliche Studien über die Nebenhöhlen der Nase bei menschlichen Embryonen, *Nagasaki Igakkwai Zasshi* **15** 1144 (July 25) 1937, Histologische Studien über die Nebenhöhlen der Nase bei menschlichen Embryonen, *ibid* **15** 1381 (Aug 25) 1937, Beziehungen der Nasennebenhöhlen der japanischen Embryonen mit der äusseren Nase, dem Schädel und ihrer eigenen nächsten Umgebung, *ibid* **15** 1397 (Aug 25) 1937.

nineteenth week, but globlet cells do not appear until the end stage of the embryo. The anlage of the mucous glands can be seen in one corner of the primitive maxillary sinus in the ninth week, however, it is not until the fourteenth week that the glands become branched into typical tubuloacinous form. The author describes the appearance and development of the various meatuses and turbinates, showing the various stages of their growth and their relation to the development of the sinuses. Discussing the appearance of the most anterior ethmoid cells, Honda states that he saw no indication of a frontal sinus ever developing from these cells. His specimens all showed the frontal sinus arising from the frontal recess, which appears in the eighth week and begins pouching in the thirteenth or the fourteenth week. Its shape is extremely variable and its growth much slower than that of the first three ethmoid cells, which also arise from the frontal recess.

The general direction of growth of the frontal and ethmoid sinuses is forward, that of the maxillary and sphenoid sinuses, backward. The author points out that at the end of the embryonal period the sinuses are found to have developed to varying degrees, but never does a solitary cell develop from one sinus or cell nor does a cell become entirely isolated from the beginning. Up to the twentieth week the various sinuses and cells maintain their infantile shape. From the twenty-eighth week on they gradually take on more complicated forms. Despite the variety of shapes and sizes which they assume, their original points of origin, namely, the first and second principal folds, are nearly always uniform.

Blair<sup>2</sup> presented before the fifty-ninth annual congress of the American Laryngological Association a number of interesting congenital anomalies of the nose which were associated with displacement of the lids and eyeball. In 1 patient there was no evidence of a mucosa-lined cavity that might have represented the antrum. In several other patients a mucosa-lined cavity was found with its duct displaced or entirely absent. Speculation as to the source from which the mucosa was derived led to the observation that "lacking embryological data, one might imagine a nasal duct attached above directly to the upper canaliculus or to a rudimentary sac, the lower canaliculus being entirely absent."

Roentgen studies of the sinuses during infancy and early childhood by Knutsson<sup>3</sup> revealed the following facts. In the newborn the ethmoid portion of the nose forms two thirds of the total height of the

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2 Blair, V. P. Observations on Sinus Abnormalities in Congenital Total and Hemis-Absence of the Nose, *Ann Otol, Rhin & Laryng* 46:592 (Sept.) 1937.

3 Knutsson, F. Sinuses During the First Years of Life, *Nord med tidsskr* 13:606 (April 17) 1937.



nasal cavities and the maxillary sinus one third, in the adult they are equally divided, because the maxillary sinus, growing more rapidly, attains its full height through its growth downward, while at the same time the choanae are increasing in height Knutsson, like Honda, calls attention to the embryologic fact that the sphenoid sinus is really a pinched-off portion of the nasal cavity proper, whereas all the other sinuses develop from recesses in the primitive lateral nasal wall

Ennis<sup>4</sup> has written an illuminating article, profusely illustrated, which demonstrates the variations in the size of the maxillary sinus and its pockets or extensions in relation to the nasal cavity and the teeth This article is developed along the lines of a previous communication by the same author but is written particularly for the benefit of the orthodontist and the general dentist The significance of the alveolar, palatine, zygomatic and infraorbital extensions as well as the exceptional tuberosity and intermolar extensions is elaborated with the idea of demonstrating how to differentiate these spaces from cysts or areas of softened bone in relation to the teeth Incorrect diagnoses have often been made because of insufficient knowledge of the variations mentioned and of their roentgenographic appearance The author shows the value of the occlusal roentgenogram and gives detailed directions for the technic Roentgenograms taken in three positions are shown, each of which delineates a particular portion of the sinus and furnishes information not obtainable in the usual projections Ennis points out the importance of showing the typical Y formed by the nasoantral wall at the point where the nasal cavity continues anteriorly while the anterior wall of the sinus curves away from it in a lateral direction The recognition of this line is of great assistance in differentiating alveolar extensions of the sinus from a cyst in this region Nutrient canals are also located so that they may not be mistaken for pathologic changes in the bone

Mangabeira-Albernaz<sup>5</sup> expresses surprise that textbooks fail to mention the maxillofrontal canal Even Zuckerkandl, Hajek and Gruenwald make no reference to this structure Bryan is credited with the first description of it, and Vilar Fiol, with the first extensive study It is described as a deep groove or incomplete bony canal directly connecting the frontal and maxillary sinuses Fillibrown studied the structure at the suggestion of Bryan and stated that the "infundibulum instead of ending in the middle meatus continues downward in the

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4 Ennis, L M Roentgenographic Variations of the Maxillary Sinus and the Nutrient Canals of the Maxilla and the Mandible, *Internat J Orthodontia* **23** 173 (Feb) 1937

5 Mangabeira-Albernaz P O conduto maxilo-frontal, *Rev oto-laring de São Paulo* **4** 373 (Sept-Oct) 1936, Le canal maxilo-frontal, *Rev de laryng* **58** 77 (Jan) 1937

form of a semicanal ending directly in the maxillary ostium" Fiol found the canal present in 20 per cent of 140 patients examined. The author, however, in a series of 68 patients found only 2 in whom there was a structure which conformed to that described by Fiol. In both instances the maxillary end of the canal was discovered in the course of a radical operation on the antrum through a clump of granulation tissue in the posterior superior part of the nasoantral wall just above the ostium, which when cleared away revealed a depression or fossa. A sound passed into it slipped readily forward and upward and was demonstrated roentgenographically to have reached the frontal sinus. The clinical significance of the finding lies in the fact that unless the canal is freed of all pathologic tissue one may expect a recurrence of the symptoms for which the original operation was done.

Roentgen studies of 102 Japanese skulls (i. e., 204 sinuses) by Murai<sup>6</sup> disclosed a higher incidence of double frontal sinuses than in the white race, viz., 6.8 per cent as against 2.5 per cent. He found as many as 5 separate frontal sinuses in one head. The first, or primary, sinus is more medial and higher than the second, or accessory, sinus, which is usually broader and deeper. The primary sinus always opens into the frontal recess, as do most of the accessory sinuses, although in several instances the latter open into the infundibulum or the recessus bulbaris. The author found symmetric sinuses in most specimens.

Mangabeira-Albernaz<sup>7</sup> considers that in a true accessory sinus the cavity must have a separate duct leading into the nasal cavity. He cites 2 cases, in 1 of which the accessory cavity was posterior, whereas in the other it was lateral, to the true frontal sinus.

Abnormalities of the crista galli as a cause of headaches was the basis of an investigation by Borghesan<sup>8</sup>. He observed that the persistence of headache after cure of sinusitis was associated with roentgenographic evidence of an inflammatory process involving the crista galli, which in many instances was formed of diploic bone and occasionally even contained an air cell. The headaches were usually fronto-temporal. In a series of observations, clinical, roentgenographic and anatomic, he found diploic cristae in 54 per cent and pneumatic cristae in 0.5 per cent of all cases. He believes that the close relation of this structure to the meninges and the frontal, ethmoid and sphenoid bones

6 Murai, Y. Zur Kenntnis der sogenannten verdoppelten Stirnhöhlen, *Sei-I-Kai M. J. (Abstr. Sect.)* **56** 8 (Feb.) 1937.

7 Mangabeira-Albernaz, P. Da duplicidade do seio frontal, *Rev. oto-laring. de São Paulo* **4** 459 (Sept.-Oct.) 1936, Sinus frontal double, *Ann. d'oto-laryng.*, May 1937, p. 426.

8 Borghesan, E. Anomalia dell'apofisi "crista galli" considerata quale probabile fattore di cefalea, *Riv. oto-neuro-oftal.* **13** 456 (Sept.-Oct.) 1936.

may explain how abnormalities, such as thickening of the bone, diploic structure and air cells might be the cause of persisting headaches. Several illustrative cases are cited.

Dixon's<sup>9</sup> study of the sphenoid sinus was based on examination of 1,600 skulls. In 7 per cent a large cylindric ridge on the internal surface of the sinus marked the location of the optic nerve. In no skull was the bony canal of the nerve completely free in the sinus, although in 9 cases the nerve was seven-tenths surrounded by pneumatic bone. In 46 specimens the carotid artery was one-half or more surrounded by bone projecting into the sinus. Dehiscences exposing the cavernous sinus and nerves were not common. The distance from the anterior nasal spine to the ostium varied from 56.71 to 57.64 mm. in females and from 60.93 to 60.60 mm. in males, the first figure being for white persons and the second for Negroes. The average diameter of the round ostia was 5.03 mm. and of the oval ostia 4.2 by 6.8 mm. For probing the ostium, the author advises passing the probe to the anterior surface of the sphenoid sinus where

the sense of touch will tell whether the anterior wall is perpendicular or sloping. If the wall faces downward or is perpendicular, the ostium faces forward, while if the surface slopes acutely backward, the ostium will face the cribriform plate. After ascertaining the slope of the anterior wall, the probe is bent laterally to the curve of the middle turbinate and raised to the junction of the septum and the roof. If this roof seems abnormally low, then a posterior ethmoid cell should be thought of and the ostium will be not far below this cell, approximately 2.4 mm. from the septum. If the junction of the septal wall and the cribriform plate were high, then the center of the average ostium would be 8.25 mm. inferiorly and 4.92 mm. externally to the septal wall.

#### PATHOLOGY AND BACTERIOLOGY

Richter<sup>10</sup> states that while congenital factors influencing the development of the sinuses have been well worked out by Albrecht and Schwartz, exogenous factors are not so easy to demonstrate, because the tissues are not under observation during their development, only the end results being available for study. Since it is known that ozena is definitely associated with retarded development of the sinuses, the author reviewed the results of examination of 244 patients seen at the Erlanger Clinic from 1931 to 1933. As a result of roentgen studies of 52 patients, 27 were found to have small frontal sinuses. The 25 persons with normal frontal sinuses did not show signs of ozena until the age of 20, when the sinuses were already developed. Persons with congenital syphilis make possible the study of the effect

9 Dixon, F. W. A Comparative Study of the Sphenoidal Sinus, *Ann. Otol., Rhin. & Laryng.* **46**: 687 (Sept.) 1937.

10 Richter, H. Ueber exogene Einflüsse auf die Entwicklung der Nasennebenhöhlen, *Arch. f. Ohren-, Nasen- u. Kehlkopfh.* **143**: 251, 1937.

of the disease on the development of the sinuses. In infants the condition is called *coryza syphilitica neonatorum*. The author's studies of serial sections of the sinuses of 24 fetuses and infants showed hyperplasia of the mucosa with a tendency to polypoid formation. The vascular supply was rich, and there was considerable round cell infiltration, especially about the small vessels. Ossification was found to be retarded, although the cartilaginous capsule was intact. Calcification was absent in areas, and osteoblasts were less numerous than in normal sinuses. The author feels that the mucosa in these sinuses possesses little pneumatizing drive and therefore that underdeveloped sinuses in later life can be definitely ascribed to the disease.

Histologic studies of the mucosa of the sinuses of 32 subjects dying of exanthematous typhus were made by Beresniak<sup>11</sup>. In 11 sinuses (8 patients) changes characteristic of typhus were found. These are hyperemic succulent mucosa and an accumulation of lymphoid elements around the dilated blood vessels, with the formation of nodules resembling exanthematous nodules. The author points out that since in most of these cases the involvement of the sinuses is not recognized during life, there is a great element of danger that the persons who recover may be carriers. It is therefore important that the sinuses be carefully examined before a patient is discharged from quarantine.

Griffiths<sup>12</sup> introduced dyes into the sinuses of cats and dogs and followed their course through the lymphatics to the submaxillary glands, the upper and middle cervical glands, the tonsils and the bronchial glands. To prevent contamination, the experiments were repeated after the tonsils were completely embedded in the pharynx by stitching over the loose folds of mucous membrane in front and behind the tonsils. The dyes were again recovered from the tonsils. The author contends that since the tonsils seem to act as filters for toxic products originating in the sinuses, it is a mistake to remove them from children who are suffering from "nasal catarrh" until the sinuses are examined and cleared of infection. Of a series of 5,000 children with involvement of the nose and throat, 385 were found to be suffering from sinus infection. Furthermore, sinusitis was more common in children without tonsils than in those with tonsils.

On the basis of histologic studies of 113 specimens of mucosa removed from 91 patients, Heerup and Kettel<sup>13</sup> conclude that Manasse's

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11 Beresniak, I. D. Modifications histo-pathologiques dans les sinus paranasaux au cours du typhus exanthématique, *Rev. de laryng.* **58** 916 (Sept-Oct) 1937.

12 Griffiths, I. Function of the Tonsils and Their Relationship to the Etiology and Treatment of Nasal Catarrh, *Lancet* **2** 723 (Sept 25) 1937.

13 Heerup, L., and Kettel, K. Vergleichende histopathologische, bakteriologische und klinische Untersuchungen bei chronischer Kieferhohlenentzündung, *Acta oto-laryng.* **25** 471, 1937.

classification of chronic maxillary sinusitis into three types is essentially correct. These are the edematous, the chronic glandular and the fibrotic type. They found no connection between bacterial findings and the type of histologic change encountered, however, they did observe a connection between the type and quantity of secretion and the histologic appearance. The greatest amount of purulent discharge was found to be associated with chronic granular mucosa. This is accounted for by the unusual thickness of the membrane and the marked increase of cellular infiltration in all its layers. The authors could find no direct association between the allergic state and the number of eosinophils in the mucosa. They conclude that eosinophils are scarce in acute conditions and are found in large numbers only in the strictly edematous states. Metaplasia of the cylindric epithelium into the squamous type was found in only 13 of the 113 specimens studied, which differs materially from Oppikofer's statistics, in which 41 per cent of the specimens showed such changes. The authors state that Manasse found no instances of true metaplasia.

Malgeri<sup>14</sup> cites a case of global aplastic myelosis with involvement of the antrum in a woman of 49. The spleen was removed, and roentgen irradiation was administered without avail. Examination of the blood showed 1,350,000 red blood cells and 600 white blood cells, with a hemoglobin content of 21 per cent, 30 per cent neutrophils, 6 per cent eosinophils, 52 per cent lymphocytes, 2 per cent basophils and 10 per cent monocytes. A Caldwell-Luc operation showed the antrum filled with pus and friable myxomatous masses, which were especially prolific in the region of the ethmoid sinus. Histologic examination disclosed masses of mononuclear planocellular types and a few mononuclear eosinophils infiltrating the tissues.

Szende and Muranyi<sup>15</sup> believe that a knowledge of the bacterial offender in cases of sinusitis is of great value in directing the therapy, particularly in cases of acute infection. Secretions withdrawn under aseptic precautions in 50 cases revealed mostly pneumococci and catarrhal diplococci in the cases of acute involvement. The pneumococcic secretion was pale yellow or greenish and flocculent in consistency. The diplococcic secretion was milky and cloudy. The pneumococcic infection in several of the cases yielded promptly to irrigation with a pneumococcus serum. Streptococci were recovered in 13 of 21 cases of chronic involvement, staphylococci in 1 and a mixed flora in 7. Radical

14 Malgeri, G. Mielosi globale aplastica e complicazione al seno mascellare, *Valsalva* **13** 312 (July) 1937.

15 Szende, B., and Muranyi, L. Bakteriologie der akuten und chronischen Kieferhohlenentzündungen und ihre Bedeutung für Prognose und Therapie, *Ztschr f Hals-, Nasen- u. Ohrenh* **40** 638, 1937.

operation was performed in 12 of these cases. The authors used irrigations of a polyvalent streptococcus and staphylococcus serum and also a solution of a silver preparation in a concentration of 1:10,000, with good results and no damage to the mucosa. Fusobacillary infections yielded to irrigation with iivanol (an acridine dye derivative) followed by the instillation of 5 cc. of a 2 per cent solution of acriflavine hydrochloride.

#### DIAGNOSIS

Le Mee and Bouchet<sup>16</sup> claim that displacement with iodized oil yields valuable information with regard to the ethmoid cells. It permits one to locate aberrant cells and exceptional prolongations which when infected give rise to unusual symptoms. It helps in making the diagnosis of serous sinusitis and allergic reactions in certain persons, and finally the procedure enables one to observe the rate of absorption and elimination from the sinuses. The authors illustrate the value of displacement by presenting roentgenograms of 3 patients, in each instance the usual flat roentgenograms failed to disclose the unusual conditions present. In 1 case iodized poppyseed oil showed a large cell in the region of the pterygoid bone which was responsible for typical neuralgia of the vidian nerve. In another case a cell was located in the orbital floor close to the infraorbital foramen, causing neuralgia of the facial nerve. In the third case a large mucocele was disclosed which caused marked nasal obstruction. The authors' studies showed the rate of absorption of the oil and its passage through the lymphatics down to the thoracic lymph glands. Because of reports of ill effects from the use of iodized oil the authors have given up using iodized poppyseed oil 40 per cent and are employing a 10 per cent concentration in cod liver oil. In some cases they found an oxide of colloidal thorium dioxide agreeable and nonirritating.

De Lima<sup>17</sup> accomplishes displacement with a thin iodized oil by placing the patient in the Parkinson position (lateral with head low) and having him attempt to inhale forcibly while the nostrils are closed with the thumb and the forefinger, thus creating a vacuum within the nasal chambers. Several cubic centimeters of oil is again instilled and the procedure repeated, the patient alternating forced inhalations with quiet exhalation through the mouth until the sinuses are filled. The author uses up to 10 cc. of fluid and claims that this procedure is simple,

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16 Le Mee, J, and Bouchet, M. De la valeur diagnostique des radiopaques dans l'étude des ethmoïdites et des sinusites sereuses, *Ztschr f Hals-, Nasen- u Ohrenh* 40 587, 1937

17 de Lima, E. Nota previa sobre uma technica de enchimento dos seios para-nasales pelo deslocamento, *Brasil-med* 51 850 (Aug 14) 1937

adequate and easily carried out. Several roentgenograms show the sinuses well filled.

Tomography as an aid in diagnosis of infections of the deeper sinuses is extolled by Liveriero<sup>18</sup> and Camino<sup>19</sup>. It is a procedure whereby any section of the body can be studied roentgenographically without reference to the overlying or the underlying tissues. The pictures are taken by an apparatus consisting of the tube and Bucky diaphragm locked in a mechanism that rotates before the object being photographed in such a manner that the central ray passes to it at the same distance but from different angles. Since only the object in focus will always stay in focus while the superimposed and underlying tissues are out of focus, the former will show up clearly, whereas the latter will appear blurred. For example, the sphenoid sinus may be clearly shown in its entire width without the other structures obscuring it. Liveriero's article gives the technical details of the procedure, while in Camino's article there are several excellent illustrations of what the procedure can accomplish. Camino states that his time of exposure is two minutes with from 85 to 90 kilowatts and from 120 to 140 milliamperes.

Arcelin<sup>20</sup> believes that irregularities in the shape and size of the foramen rotundum are the cause of neuralgia of the supramaxillary nerve and advises roentgenographic study of this structure. The foramen is located on the lateral aspect of the body of the sphenoid bone below the sphenoid fissure, from which it is separated by an osseous bridge of varying thickness. There is a gutter of variable depth in the lateral portion of the sphenoid bone which runs from the posterior surface forward, ending at the foramen, which faces the sphenomaxillary space. Measurements by the author showed the axis of the foramen to be at an angle of 10 degrees to the sagittal plane and at an angle of 15 degrees to the plane of the base. The difference between these two angles is what makes it difficult to get a good roentgenographic projection showing the true axis of the foramen. The author uses the nasion-ion line for his base line in figuring the angles. Several illustrations taken posteroanteriorly show the foramen through the orbit with the principal ray in line with the groove of the foramen, so as to show its maximal width.

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18 Liveriero, E. Tomografia nel campo dell'otorinolaringologia, *Valsalva* **13** 305 (July) 1937.

19 Camino, M. Tomographie des sinus crâniens, *Bull. et mem. Soc. de radiol. med. de France* **25** 469 (June) 1937.

20 Arcelin, F. L'exploration radiographique du trou grand rond, *Lyon med.* **160** 267 (Sept. 12) 1937.

Kornblum <sup>21</sup> discusses the difficulties in interpreting roentgenograms of the sinuses because of varying technics and diverging opinions. He suggests that each hospital have one rhinologist go over every film with the roentgenologist, taking into consideration the clinical history and local findings, and report their joint interpretation at stated intervals.

Watson-Williams <sup>22</sup> presents a series of illustrations showing methods of introducing cannulas into the antrum and the posterior ethmoid and sphenoid sinuses. For the antrum he has two differently curved puncture trocars for use in the middle and inferior meatuses. He points out the difference between sounding a posterior ethmoid sinus and the sphenoid sinus and shows the relation of these sinuses to adjacent structures. He also stresses the importance of the nasopharyngoscope and presents an illustration of the type made by Mayer, of London. The illustrations make the article graphic and emphasize the fundamentals of instrumental aid in diagnosis.

Matsuda <sup>23</sup> credits Watson-Williams with the trocar and cannula which he has found useful in puncturing the sphenoid sinus. He uses a straight cannula 9.2 cm long and 1.2 mm in diameter, with an outer tube about 0.7 cm shorter. It has two mandrins, a sharp one as long as the cannula and a dull one, which is 2 cm longer. He prefers the sharp one. The author finds by study of cadavers as well as of living patients that the trocar can be safely inserted if it crosses the middle turbinate along the posterior third of the lower border.

Hondelink <sup>24</sup> has found Mittermaier's method of instilling a barium preparation into the antrum most successful in the diagnosis of tumors and abnormalities of the interior of the sinus. He reports 3 cases. In 1 the roentgenogram showed a fold of mucosa running from the floor to the roof, which at operation was proved to contain a nerve which had been the cause of severe pains. In several other cases the diagnosis of polyposis and hyperplasia was proved at operation.

#### ORBITAL AND OCULAR COMPLICATIONS

In a report of a symposium on orbital cellulitis before the Royal Society of Medicine, Davis <sup>25</sup> says that in 39 of 54 cases (72 per cent)

21 Kornblum, K. A Roentgenologist Looks at Sinus Disease, *Am J Roentgenol* **38** 48 (July) 1937

22 Watson-Williams, P. Tecnica personale di esplorazione dei seni paranasali, *Arch ital de otol* **49** 80 (Feb) 1937

23 Matsuda, E. Ueber die Probepunktion der Keilbenhohle und deren diagnostische Bedeutung, *Oto-rhino-laryng* **10** 923 (Oct) 1937

24 Hondelink, H. Das Laktobaryt zur Reliefdarstellung von umschriebenen Veränderungen an der Schleimhaut der Kieferhohlen, Hals-, Nasen- u. Ohrenarzt (Teil 1) **28** 34 (Feb) 1937

25 Discussion on Orbital Cellulitis Due to Sinus Infection and Its Treatment, *Proc Roy Soc Med* **30** 1397 (Sept) 1937



reviewed by him the condition was due to suppuration of a sinus. In his experience the frontal sinus is the most frequent offender in adults and the ethmoid sinus in children. In 37 of the 39 cases cited an external incision was made and intranasal drainage instituted. One patient recovered spontaneously, while another died as a result of meningitis which was present prior to operation. Mygind<sup>24</sup> reviews 121 cases of orbital cellulitis and states that for the period from 1906 to 1920 77 per cent were found to be due to sinus infection, while from 1923 to 1937 the percentage reached 81. Since in many cases it is difficult to differentiate between simple edema and an abscess, he advises conservative treatment until one can be certain of the diagnosis. Only the presence of alarming symptoms should lead to early operation. Howells<sup>25</sup> also advises conservatism. Capps<sup>26</sup> states that proptosis indicates cellulitis and defines the manner of examination by which one may determine even a slight difference between the two eyes. If the diagnosis is in doubt, he always makes an incision, and he prefers the ophthalmologist's simple incision, leaving the periosteum alone. Watson-Williams<sup>27</sup> points out the distinction between periorbital abscess and cellulitis of the intraorbital tissues. The latter is less frequent in his experience and carries greater danger to the vision. In cases of periorbital abscess the eye is pushed outward and downward and ocular movements are less disturbed than in cases of true orbital cellulitis, in which the chemosis is marked and the eye is pushed forward.

Schreyer<sup>28</sup> reports 19 cases of orbital complications, in 15 of which they followed acute infections. He finds that trauma and early operation often lead to such complications. In 1 case they were due to the use of massage and light baths, in another, they followed extraction of a tooth. He cautions against early puncture of the antrum in cases of acute involvement and cites 3 cases from Bieslau in which severe pyemia followed this procedure. Aside from the cases in which the complications were chronic or were due to trauma, the average time from the onset of acute infection to the appearance of orbital symptoms was from ten to fourteen days. The ethmoid sinus was involved in all of his cases, the maxillary sinus in 12 and the frontal sinus in 9. The author refers to Leroux's article on the importance of chronic infection of the ethmoid sinus in children as a cause of chronic disease of the lungs, gastrointestinal tract and recurring colds. Ten children, despite a history of normal sinuses, showed evidence of chronic infection of the ethmoid and maxillary sinuses. Such infections are easily lighted up by a fresh cold and may readily lead to an orbital

<sup>26</sup> Schreyer, W. Ueber orbitale komplikationen bei Nasennebenhohlentzündungen, *Ztschr f Hals-, Nasen- u Ohrenh* 41 432, 1937

complication Schreyer favors conservative treatment as far as possible barring the presence of intracranial complications. However, none of the adults in his series was cured by treatment by the endonasal route alone. The external operation was performed for drainage, and the diseased sinus was cleaned out intranasally when the acute symptoms had subsided, in 1 case as late as eighteen days after the external incision. His intranasal procedure is to intact the middle turbinate with a Killian speculum and then to push the speculum directly into the mass in the ethmoid sinus so as to open it bluntly for drainage.

Gault, Grimaud and Blum<sup>27</sup> report 2 cases which exemplify the difference between a deep orbital cellulitis and a periorbital phlegmon. In the case of deep orbital cellulitis the symptoms were mild and responded promptly to conservative measures, yet the patient lost his vision. In the case of periorbital phlegmon there was a large abscess along the internal wall extending far back which gave rise to marked general symptoms, the patient recovered, with no loss of vision.

Rendu and Rollet<sup>28</sup> also try to bring out the difference between these two conditions. True orbital cellulitis is characterized by fixation of the eyeball, exophthalmos and marked palpebral edema and is a definite indication for early incision. The evolution of suppuration is marked by an increase in the general symptoms and the appearance of corneal anesthesia and dilatation of the pupil.

Sargnon and Paufigue<sup>29</sup> present the results of a clinical study along the lines of the articles just mentioned and call attention to the comparatively benign superficial palpebral infections as contrasted to the more serious deep cellulitis. The former is more frequent in children and yields to physical therapy plus simple incision if pus is present.

Hubert's<sup>30</sup> article is based on a study of 114 cases of orbital infections, which were divided into five groups. The first group consisted of 31 cases of simple edema of the lids with or without edema of the orbit. Conservative measures were successful in 20; an incision was made in 1 case without pus being found, a middle turbinate was removed in 1 case, and external operation was performed in 9. Five of the patients died, 1 of meningitis and 4 of abscess of the brain. The second group consisted of 46 cases of subperiosteal abscess, in 37 of which the lids were involved. All the patients recovered after

27 Gault, Grimaud and Blum. Phlegmons de l'orbite d'origine sinusienne, suivis de guérison, *Bull. Soc. d'opht. de Paris*, April 1937, p. 271.

28 Rendu, R., and Rollet, J. Fluxion orbitaire avec exophtalmie au cours d'une fronto-ethmoïdite de l'enfance, *Lyon méd.* **159** 168 (Feb. 7) 1937.

29 Sargnon and Paufigue. Le fluxion orbitaire d'origine naso-sinusale, *Valsalva* **13** 337 (July) 1937.

30 Hubert, L. Orbital Infections Due to Nasal Sinusitis. *New York State J. Med.* **37** 1559 (Sept. 15) 1937.

operation. The third group was made up of 22 cases of orbital abscess. Two of the patients died of meningitis and 1 of abscess of the brain. Nine cases of orbital cellulitis with phlebitis and sepsis, composed the fourth group. Six of the patients in this group died of meningitis. The fifth group consisted of 2 cases of thrombosis of the cavernous sinus, both of which proved fatal. Conservative treatment was employed in the first group, except in the cases of acute fulminating sinusitis in which external operation has always yielded poor results. Good results were obtained in the second group with simple incision and drainage. In the third group the orbit was exposed, and if the bone and fascia were intact, an incision was made into the orbital fascia and drainage instituted. In the fourth group of cases, those in which the infection spread via the venous channels, the orbital fascia was opened widely and at the same time the offending sinus was opened so as to decompress the orbital contents and relieve the pressure on the optic nerve.

Chavira<sup>31</sup> does not believe that oculo-orbital complications are as frequent as claimed by some. In some cases the connection between the sinus infection and the orbital complication is clear and in others it is obscure. Several interesting cases are cited. In 1 instance a patient had swelling of the internal angle of the orbit for several months without inflammatory signs affecting the eye, yet at operation an indolent abscess was found, with erosion of the roof of the orbit and exposure of the dura. In another case, that of a child with primary maxillary sinusitis, some painful teeth were extracted, resulting in infection of the cheek and extension from the antrum to the ethmoid and frontal sinuses, with such orbital symptoms as exophthalmos and restricted ocular movements. The abscess ruptured spontaneously at the internal angle, and at operation the floor of the frontal sinus was found to be eroded. In case 3 a rapidly progressing optic neuritis was found to be due to infection of the sphenoid sinus and was cured by removal of the middle turbinate and opening of the sinus. In case 5 a mucocele of the frontal sinus was found associated with Rollet's sign, namely, hyperostosis of the floor of the frontal sinus and the junction with the nasal bones. The growth consisted of a compact mass of solid bone at the root of the nose, which was easily demonstrated roentgenographically.

Lopes<sup>32</sup> gives an extensive review of the whole subject of orbital and ocular complications, including a consideration of the topical

31 Chavira, R. A. Complicaciones oculares en algunas sinusitis, *Rev. mex. de cir., ginec. y cancer* 5 231 (May) 1937, *An. Soc. mex. de oftal. y otorinolaring.* 11 283 (April-June) 1937.

32 Lopes, O. Complicacoes oculo-orbitarias da sinusite maxilar, *Rev. otorinolaring. de São Paulo* 4 1075 (Nov-Dec) 1936.

anatomy of the structures involved, and quotes from Le Maitre's book on the classification of oculo-orbital complications originating from infection of the sinuses. Eleven cases are reported, including cases of iritis, amblyopia, retrobulbar neuritis, orbital cellulitis and orbital thrombophlebitis. While the complications in most of the cases were attributed to infection of the maxillary sinus, the histories indicate involvement of other sinuses as well. Only in a few of the non-suppurative complications could the maxillary sinus be definitely blamed for the complication.

Genet and Mounier-Kuhn<sup>33</sup> state that some orbital abscesses have a close resemblance to genuine tumors of the orbit. They report 10 such cases. Since ocular symptoms overshadow the nasal symptoms, the connection may be lost sight of. Usually the process begins with ocular pains followed by exophthalmos and swelling of the lids. Palpation may differentiate the condition from tumor, which is more dense and less inflammatory. There may be dilatation of the pupil, swelling of the retinal veins, impairment of the fields and loss of vision. Roentgen studies are of paramount importance in the diagnosis and location of the focus in the sinus. The authors favor adequate intra-nasal drainage and avoid external operation whenever possible.

Retrobulbar neuritis is thoroughly discussed by Sourdille,<sup>34</sup> who operated on 25 patients with signal success. After an extensive study of the anatomic and histologic data, he concludes that retrobulbar neuritis is in most cases due to infection of the opticochiasmatic meningeal spaces, which become involved by extension from the posterior sinuses. He claims to have proved a direct connection between the two areas and demonstrates it in several graphic drawings. When there is a history of a recent nasal infection immediately preceding the onset of a retrobulbar neuritis, he urges early operation despite the absence of local evidence of sinusitis. Bilateral scotomas, frontal or occipital headaches and papillary edema should be enough to warrant opening the sinuses. The author insists on the nonspecific nature of the procedure and goes on the assumption that even the presence of a definite etiologic factor, such as multiple sclerosis, encephalitis or syphilis, is no contraindication to the operation provided the medical treatment has been tried and found unsuccessful. He claims that under normal conditions the optic nerves can successfully defend themselves against infection, but if the anatomic conditions are abnormal, such abnormalities must be corrected before the nerve will respond to treatment.

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33 Genet, L., and Mounier-Kuhn, P. Les pseudo-tumeurs de l'orbite par dilatation des sinus de la face, *Ann d'oto-laryng*, April 1937, p. 327.

34 Sourdille, G. P. Lésions anatomiques endocraniennes dans la neurite rétrobulbaire, *Arch d'opht* 13 (Jan.) 1937.

Segura <sup>35</sup> is practically in agreement with Sourdille on this subject and states that in his experience the anatomic conditions predisposing to optic neuritis are mainly a large sphenoid sinus and an optic nerve the bony canal of which partly traverses the sinus. Roentgenograms have proved this juxtaposition many times to his complete satisfaction. He has had excellent results from an operation which he does not hesitate to undertake in all cases in which the cause is obscure or medical treatment fails to yield prompt relief. He does not find it necessary to open the posterior ethmoid sinuses but confines his surgical treatment to the endoseptal approach to the sphenoid sinuses, both of which are opened widely. The lining is not removed unless palpably diseased. The author states that even a positive Wassermann reaction or the presence of tabes is no contraindication to the operation, since his experience has proved that the condition in many of these cases fails to respond to the therapy until the sphenoid sinuses are opened.

Escat <sup>36</sup> is another who holds the same views as those just mentioned. Since his article on this subject in 1928 recommending early ablation of the middle turbinate and opening of the sphenoid sinus, he has operated in 29 cases, with cure in 21. He still upholds the practicability of the procedure regardless of whether the Wassermann reaction is positive or not. The operation does not interfere with antisyphilitic treatment and yields a high percentage of early cures irrespective of the presence or absence of a gross pathologic process. He is of the opinion that recovery is due in large measure to the relief of the sympathicotrigeminal reflex, as described by Caneghem and Sargnon.

Giacobbi,<sup>37</sup> like Sargnon, has found optic neuritis in association with extensively pneumatized sphenoid sinuses and reports 3 cases in which operation yielded prompt recovery despite the absence of a gross pathologic process. He also believes in the theory of a reflex nervous mechanism as an etiologic factor.

Kafka <sup>38</sup> presents a statistical survey of records from New York University College of Medicine and the Bellevue Hospital with reference to oculo-orbital complications. In 10 cases of retrobulbar neuritis a definite pathologic process was demonstrated in one or more of the

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35 Segura, E. V. Les nevrites retro-bulbaires, *Ztschr f Hals-, Nasen- u Ohrenh* 40 594, 1937

36 Escat, E. Action résolutive sur certaines nevrites optiques exclusives de toute propathie nasale ou naso-sinusale de l'exerese du cornet moyen normal et de la trepanation endonasale du sinus sphénoïdal correspondant. Derniers resultats, *Ann d'oto-laryng*, February 1937, p 93

37 Giacobbi, L. Sui rapporti tra abnorme pneumatizzazione dei seni sfenoidali e neurite ottica, *Riv oto-neuro-oftal* 14 317 (May-June) 1937

38 Kafka, M. M. The Relationship of Sinus Diseases to the Diseases of the Eye with Review of Fifty-Two Cases, *Laryngoscope* 47 272 (April) 1937

sinuses The condition in 6 cases was unimproved because of lack of cooperation on the part of the patients

As to other ocular complications, the most important contribution is Gill's report<sup>39</sup> amplifying his previous paper<sup>40</sup> on the subject of the relation of uveitis to sinus disease He presents the results of study of a group of 230 patients, including the group previously observed "The type of uveitis with which we are concerned in the article is the insidious, low grade, essentially chronic type of inflammatory reaction involving the vascular structures posterior to the iris in which the principal etiological factor is regarded by many authorities to be one or more chronic foci of infection" Infection of the paranasal sinuses was present in 40.8 per cent of his patients, the ethmoid sinuses being involved in more than half of them His diagnostic methods included the removal of tissue and the demonstration of the presence of a rarefying or condensing osteitis involving the walls of the ethmoid and sphenoid sinuses Also in most of the cases there was definite hypertrophy of the mucous membrane Twenty-eight patients were subjected to intracutaneous uveal pigment test, and the responses varied from mild erythema to severe reactions, with vesicle formation and ulceration Treatment of the sinus must be thorough in order to avoid residual infection, which may prolong the trouble

Posarelli<sup>41</sup> proposes the term "dacryosinusitis" for an infection of the lacrimal sac secondary to disease of the sinuses and presents a mass of clinical roentgenographic and histologic evidence to prove that such a sequence is not only frequent but plausible He finds that the venous channels are the most common pathways of the spreading infection, although in some cases it passes from the sinuses to the lacrimal sac by direct contiguity of tissue

A case of infective keratitis in which the infection was resistant to treatment is reported by de Cerqueira Falcão,<sup>42</sup> prompt recovery followed a bilateral Caldwell-Luc operation The author refers to some excellent reports on the same subject by Professor Moraes, of Bahia

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39 Gill, W. D. The Clinical Relationship of Infections in the Upper Respiratory Tract to Certain Types of Chronic Posterior Uveitis. Supplementary Report, *Ann Otol, Rhin & Laryng* **46** 643 (Sept.) 1937

40 Gill, W. D. The Clinical Relationship of Infections in the Upper Respiratory Tract to Certain Types of Chronic Uveitis. Preliminary Report, *Ann Otol, Rhin & Laryng* **44** 486 (June) 1935

41 Posarelli, A. Sulla dacrio-etmoidite, *Riv. oto-neuro-oftal* **13** 555 (Nov.-Dec.) 1936

42 de Cerqueira Falcão, E. Corneal Ulcers Due to Sinusitis, *Brasil-med* **51**: 341 (March 6) 1937

Pressman<sup>43</sup> reports an interesting case of nitis in which no focus of infection could be found except a suspicious clouding of the right (contralateral) sphenoid sinus. The sinus was opened through its anterior wall under the inflated middle turbinate, with temporary relief. Recurrence of the nitis and the fact that the irrigating fluid escaped from the side opposite the sinus operated on led to roentgenographic examination with a probe in place. This disclosed that although the operation was done on the right side, in reality it was the left sphenoid sinus which had been opened since it was so large that it extended beyond the midline, encroaching on the space normally occupied by the right sphenoid sinus. Subsequent probing located the opening of the right sphenoid sinus high up in the extreme sphenoid recess. Adequate treatment was followed by recovery.

Hatschek<sup>44</sup> reports a case in which sarcoma originated in the sphenoid bone and invaded the orbit, causing exophthalmos. The latter was the only symptom present for a long time, and the author stresses the importance of careful and frequent roentgenographic studies to differentiate a primary retro-orbital tumor from a secondary growth. In this case, as in others heretofore reported, the symptoms of intracranial pressure are absent until late in the process.

#### INTRACRANIAL COMPLICATIONS

Neal, Jackson and Appelbaum<sup>45</sup> divide the treatment of septic meningitis into surgical, serologic and chemical.

Their surgical treatment consists of elimination of the original focus and repeated spinal puncture. They find the latter just as efficient for drainage as laminectomy or cisternal puncture. Forced drainage (Kubie) has not proved satisfactory and has been abandoned.

Then results with serologic treatment have not been good except in cases of meningococcic meningitis. In cases of pneumococcic meningitis serologic treatment has been a failure, but in some cases of streptococcic meningitis they have obtained good results, particularly in cases of scarlet fever.

The authors have given up the use of various dyes in chemical treatment. Ethylhydrocupreine hydrochloride is still found to be useful in the treatment of pneumococcic infections. They do not favor the intra-

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43 Pressman, J. J. Iritis Caused by Asymptomatic Sphenoiditis with Anomaly of the Sphenoid Sinus, *Arch Otolaryng* **26** 83 (July) 1937.

44 Hatschek, G. Ein Beitrag zur Diagnose und Pathologie intrakranieller Tumoren im Bereich des Keilbeinflügels mit Durchbruch in die Augenhöhle, *Folia ophth orient* **2** 328, 1936.

45 Neal, J. B., Jackson, H. W., and Appelbaum, E. A Summary of Methods Used in Treating Meningitis Secondary to Infections of the Ears and Sinuses, *Laryngoscope* **47** 317 (May) 1937.

carotid route for the injections. They have had excellent results with sulfanilamide, especially in cases of meningitis due to the hemolytic streptococcus. They find no advantage in intraspinal injections and recommend the combined oral and intramuscular administration of moderate doses such as from 5 to 10 cc of prontosil (the disodium salt of 4-sulfamidophenyl-2'-azo-7'-acetylamino-1'-hydroxynaphthalene-3'-6'-disulfonic acid) every four hours and from 5 to 15 grains (0.32 to 0.97 Gm.) of sulfanilamide every six hours. For children they follow the routine recommended by Bliss and Long, namely, the administration of 1 cc of prontosil per pound of body weight per twenty-four hours.

Worms<sup>46</sup> is impressed with the frequency of meningeal symptoms occurring in the course of and as a result of sinus disease and reports several pertinent cases. These are cases in which meningeal symptoms, such as headache, Kernig's sign, stiff neck, increased spinal fluid pressure, pleocytosis and impaired vision, are all present but bacteria are absent. Often epileptiform seizures and psychic disturbances occur. He believes that the symptoms are due to transmission of toxins via the lymphatics or the olfactory filaments from the nasal passages to the meninges, causing stasis of the increased cerebrospinal fluid. In some of his cases the sinus disease was not openly manifest but careful examination plus roentgenographic studies revealed the pathologic process, eradication of which was followed promptly by a cessation of the meningeal symptoms.

As a result of histologic and postmortem studies, Balzano<sup>47</sup> claims to have demonstrated the passage of infection from the sphenoid sinus to the optic chiasm and to the meninges by way of the nerve sheath and communicating veins. He found that the chronic hypertrophic type of sphenoiditis with polypoid-papillary thickening was particularly likely to lead to spread of infection beyond the sinus. In his opinion it is due to blocking of the ostium and stagnation of infective secretions, and in such cases he has shown that the infection is carried to the meninges by way of the lymphatics.

Grimaud and Blum<sup>48</sup> present a problem in diagnosis. A man 65 years of age was seen in stupor, but no antecedent history was available. A fistula discharging pus was present in the inner third of each upper lid, leading directly to the bone; there was slight chemosis but little inflammatory reaction; the fundi were normal and pus was present in both middle meatuses. Since there was no evidence of uremia or

46 Worms, G. *Etats méningés d'origine rhino-sinusienne*, Paris méd 2 250 (Oct 2) 1937.

47 Balzano, I. *Sinusite sfenoidale e diffusione flogistica periotica e meningee, Oto-rino-laring ital* 7 351 (Aug) 1937.

48 Grimaud, R. and Blum, A. *Méningite consécutive à une pansinusite*, Rev. med de Nancy 65 126 (Feb) 1937.



diabetes, the symptoms seemed to point to cerebral infection. The absence of meningeal symptoms, the presence of stupor, the indolence of the local lesions and the slight degree of fever seemed to point to gumma with cerebral extension, and pending the outcome of the Wassermann test active treatment with mercuric cyanide was instituted. There was slight improvement, and two days later roentgenograms were taken. The next day the patient died, and autopsy disclosed osteoporosis of the skull, leptomeningitis, abscess of the frontal lobe, necrosis of the sphenoid bone and thrombosis of the cavernous sinus, also pansinusitis with invasion of the orbit. The author was amazed at the extent of the pathologic process in view of the paucity of symptoms elicited and defends his original diagnosis on the basis of the indolence of the lesions in the usual site of predilection for gummas. He attributes the absence of meningeal symptoms to the walling off of the infection in the silent frontal area. (One wonders why the intranasal findings were ignored and why there was so much delay in obtaining roentgenograms. Also, abscess of the frontal lobe would have been a much better guess in view of the general ensemble.)

Kramer<sup>49</sup> lists sources of infection of the endocranium as follows: (1) osteitis of intervening bone, (2) osteomyelitis, (3) phlebitis, and possibly a combination of these three conditions, (4) direct spread of infection through dural and neural polypi, (5) infection through a defect in the cranial wall of the sinus and (6) infection through perivascular lymph spaces.

In addition, there is clinical evidence but no microscopic proof of the following sources of infection: (1) orbital infection from sinusitis with subsequent spread by way of vessels or directly through the orbital fissure, (2) involvement of the pterygomaxillary fossa and extension through foramina or by way of the veins, (3) extension by way of the pterygomaxillary space through osteomyelitis of the inferior maxilla, then through the orbit or by way of the vessels and (4) metastases from distant foci.

Becco<sup>50</sup> reports a case of abscess of the frontal lobe in a boy of 17 following acute rhinitis with swelling and tenderness of the supra-orbital region and subsequent recovery. Roentgenograms showed blurring of the upper margin of the frontal sinus. Operation disclosed pus and granulations and a communication with the opposite sinus, which was also involved. After a few days headache, vomiting, slow pulse and prostration appeared. The spinal fluid was under pressure.

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49 Kramer, R. The Pathways of Infection from the Paranasal Sinuses, *Laryngoscope* **47** 304 (May) 1937.

50 Becco, R. Absceso del lobulo frontal de origen sinusal, *Rev Asoc med argent* **50** 219 (Feb) 1937.

Reoperation disclosed an area of osteitis of the posterior wall of the frontal sinus. The dura was under tension. Puncture revealed pus, and about 10 cc was evacuated, drainage was effected by means of a rubber tube. The offending organism was a "diplostreptococcus."

Howarth<sup>51</sup> reports 2 cases of abscess of the frontal lobe. In 1 the abscess was opened and drained six months after an attack of frontal sinusitis with an external fistula. A cerebral hernia followed, which subsided gradually. The patient was free from symptoms for four months, when he suffered sudden loss of consciousness for two days with spontaneous recovery. He remained well for five years, although the vision was poor. During this period there were several attacks of loss of consciousness, and a ventriculogram showed dilatation of the ventricles, especially of the anterior horn on the affected side. At operation the ventricle was found adherent by a heavy scar to the frontal sinus and roof of the orbit. The adhesions were liberated, freeing the frontal lobe. However, the attacks persisted at the rate of from 20 to 30 a year for four years up to the time the case was reported.

In the other case, in which the symptoms were of long standing and there was a history of repeated attacks of frontal sinusitis, an abscess of the frontal lobe, located near the external angle of the orbit, was evacuated. The culture showed *Streptococcus haemolyticus*. The patient remained well for two and a half years and then suffered a sudden attack of jacksonian spasms, vomiting and headache. All of the cranial nerves were normal. The spinal fluid was clear and not under tension. Exploratory operation was done through the frontoparietal region, with removal of a large area of bone. The dura was normal, and puncture gave negative results. The patient has since had several attacks and has been under observation for eight years.

Additional cases in which there was a recurrence of symptoms after apparent cure of an abscess of the frontal lobe are reported by Just<sup>52</sup> and by Arauz and del Sel<sup>53</sup>. In the case reported by the former author symptoms such as headache, vomiting and convulsions made their appearance six months and again twelve months after the original drainage of the frontal lobe. Operation through the scarred area revealed a cystic formation, evacuation of which gave temporary relief the first time and more permanent relief the second time (seven years). Just's review of the literature on this subject reveals a consensus that the recurrence of symptoms in most cases is due to scar formation or to

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51 Howarth, W. Abces latent du lobe frontal, *Ann d'oto-laryng*, June 1937, p 513

52 Just, B. Geheilte rhinogener Stirnhirnabscess mit erneutem Auftreten von Hirnerscheinungen, *Ztschr f Hals-, Nasen- u Ohrenh* 42 199, 1937

53 Arauz, S. L., and del Sel, J. A. Absceso cerebral frontal. Post-sinusal Operación. Curación. Recidiva, *Rev Asoc méd argent* [50] 1890 (Nov) 1936

the development of a cyst. In the case reported by Arauz and del Sel the symptoms recurred two months after the abscess had been drained and included ataxia, euphoria and sudden coma. Operation disclosed a large deep-seated abscess of the frontal lobe yielding a foul green pus. Drainage was effected through glass tubing, which was later replaced with gauze treated with bismuth tribromphenate. The authors were impressed by the symptom of definite frontal ataxia as well as the anosmia and mental confusion.

A case of extradural abscess of long standing is reported by Rosenfield<sup>54</sup>. A man of 75 had had an abscess above the left eye evacuated two years previously, having refused to undergo an extensive operation, which had been advised. The wound discharged continuously, and he suffered from recurring headaches. Eventually he submitted to a more extensive operation, which disclosed erosion of the posterior plate exposing the dura over an area of about 4 square centimeters. The dura was covered with granulations and was adherent to the margins of the defect. Several small sequestrums were removed. The nasofrontal duct was blocked by fibrous tissue. Recovery ensued, with marked deformity, which, on account of the patient's advanced age, was permitted to remain uncorrected. The sinus was evidently obliterated by the operation.

An unusual case of abscess of the frontal lobe complicating acute sphenoiditis is reported by Kaplan<sup>55</sup>. With the development of cerebral symptoms, abscess of the brain was suspected, and the diagnosis was confirmed by ventriculographic examination. The abscess was approached via a large frontal flap, and drainage was effected with the Mosher drain until it extruded by herniation. The author points out the symptoms which should suggest this complication in the presence of sphenoiditis: (1) "infection of the upper respiratory tract followed some time later by frontal headaches associated with intermittent pains in one eyeball and transitory sensory disturbances of the trigeminal nerve on the same side, (2) headaches referred to the torcular, accompanied by some stiffness of the neck, (3) early papilledema, particularly fulness and tortuosity of the retinal veins, (4) slight facial weakness on the contralateral side and (5) a generalized or focal convulsion." Kaplan believes with Turner, Reynolds and Druss that the pathway of infection is by way of direct necrosis of intervening bone, although vascular pathways and dehiscences may also be contributing factors.

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54 Rosenfield, C. L. Frontal Sinus Suppuration with Extradural Abscess of Approximately Twelve Months' Duration, *M. J. Australia* **1** 293 (Feb 20) 1937.

55 Kaplan, A. Recovery from Abscess of the Frontal Lobe Secondary to Empyema of the Sphenoid Sinus, *Arch. Otolaryng.* **25** 66 (Jan) 1937.

Blondiau and Demanez <sup>56</sup> report a case of acute fulminating frontal sinusitis that developed a few hours after diving, with chills, high fever, severe pain and swelling of the lids. Roentgen examination showed a large frontal sinus with an extensive temporal recess. A few days later, the redness and swelling having extended to the parietal region, a diagnosis of erysipelas was made. Ptosis soon appeared, and the vision and pupillary reflexes were diminished. This was followed by meningeal symptoms, including cloudy spinal fluid containing 2,000 cells and pneumococci on smear. The patient would not give permission for an external operation. Intranasal drainage was instituted by resection of the middle turbinate and opening the ethmoid cells. The condition became progressively worse, and a diagnosis of abscess of the frontal lobe or of orbital abscess was considered. The patient was treated by daily lumbar puncture, with daily intravenous injections of carbon. A swelling soon appeared in the temporal region, with marked trismus, and an abscess was opened at the superoexternal angle of the orbit. Later, another abscess ruptured spontaneously through the upper lid. The patient was given injections of autovaccine and began to improve. A third abscess was evacuated directly in front of the ear. Roentgenograms revealed involvement of the frontal and maxillary sinuses. The latter was irrigated several times. A few months later an external radical operation was performed, a sequestrum measuring 4 by 3 cm was removed as well as another sequestrum from the external angle of the orbit, which explains the spread of the infection to the temporo-maxillary fossa. The exposed dura was covered with granulations. The report is unusually instructive and the recovery of the patient a tribute to the patience and conservatism of the surgeons.

#### SINUSITIS IN CHILDREN

Dean <sup>57</sup> believes that allergy predisposes the sinuses to infection by reason of the stasis and blockage it produces. The sinusitis may be due to a true allergy with sensitivity to various agents or to a vasomotor disturbance caused by dietary or endocrine imbalance. The history and examination must be thorough in order to determine the true etiologic factor and the corresponding therapeutic measures employed. When all have failed, zinc ionization may be tried, although the procedure "does have deleterious effects on the mucous membrane." In the same symposium, Mitchell <sup>57</sup> states that poorly developed sinuses in children

<sup>56</sup> Blondiau and Demanez. Sinusite frontale nécrosante compliquée, méningite à pneumocoques—guérison opératoire, *Bull. Soc. belge d'oto-rhin-laryng.*, 1937, p. 138.

<sup>57</sup> Round Table Discussion on Nasal Sinus Disease, *J. Pediat.* **10** 683 (May) 1937.

are due to the following factors (1) heredity, (2) familial tendencies, including environment, (3) infection, (4) allergy, and (5) inadequate secretion of the ductless glands. Chronic sinusitis is not usually diagnosed unless sought for as the focal agent in conditions such as nephritis, pyelitis, nervous manifestations, rheumatism, fever, cough and enlargement of the bronchial glands. Chronic maxillary sinusitis may require a nasoantral window operation. Shea,<sup>57</sup> agreeing with Dean and Mitchell in the matter of diagnosis and general treatment, enlarges on the surgical aspect of the question. He opens the antrum in the inferior meatus with a trocar and enlarges the opening with Ritter's sounds. The rubber drainage tube is kept open with oil and is removed on the fourth day. Irrigations are continued until the drainage ceases. Autogenous vaccines are given in series following the operation: one series in the fall, another during the winter and the third in the early spring. The long-continued use of ephedrine is condemned by all of the authors, as was the use of mild protein silver for any length of time. Shea prefers irrigations with saline solution and the use of the benzedrine inhaler for comfort. Whenever ephedrine is indicated, Dean advises a 0.5 per cent solution in saline solution, administered with the patient's head tipped far back.

Looper<sup>58</sup> relies on roentgen studies for the diagnosis of sinus disease in children. The nasopharyngoscope is helpful but often difficult to handle. In cases in which the diagnosis is obscure he recommends puncture of the antrum and bacteriologic study of the secretions.

Dushan<sup>59</sup> presents a complete resume of the subject of sinusitis in children from the etiologic and diagnostic points of view. He seems to think that nasal discharge is apparently increased after removal of the tonsils and adenoids, because with the obstructions out of the way the secretions flow backward more readily, causing postnasal drip and cough. He also observes that sinusitis is present in at least 50 per cent of children with otitis media.

Among the predisposing factors in the production of chronic sinusitis in children, Marks<sup>60</sup> mentions rickets as causing asymmetric development of the skull with correspondingly impaired development of the sinuses. He claims that chronic sinusitis is frequently found in the underdeveloped side of the head. In considering the diagnosis, the author describes the typical symptoms of recurrent colds, cough and loss of appetite despite recent removal of tonsils and adenoids and then gives the physical findings on which the diagnosis is based, viz., postnasal

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58 Looper, E. A. Infection of the Nasal Accessory Sinuses in Children, *M. Clin. North America* **21** 1323 (Sept.) 1937.

59 Dushan, S. S. Paranasal Sinusitis, *Arch. Pediat.* **54** 643 (Nov.) 1937.

60 Marks, H. B. Chronic Sinusitis in Children, *New England J. Med.* **216** 604 (April 8) 1937.

discharge, red glairy pharyngeal walls, enlarged cervical glands, "sinus odor" on the breath and cloudiness in the roentgenograms. In regard to treatment, especial attention to constitutional factors is stressed. The author mentions the use of a suction bulb for relief of secretions in cases of acute involvement and the prevention of aural complications. He is opposed to the use of nasal drops and quotes Proetz and Lierle in this connection.

Lindsay's <sup>61</sup> article on chronic sinusitis is based on a review of 200 cases in children 13 years of age and under. The factors predisposing to chronicity are vitamin deficiency, endocrine imbalance, allergy, improper housing and climatic conditions, also physical and chemical factors, such as an overheated dry atmosphere and the indiscriminate use of nasal medicaments. The author feels that every person with a chronic cough, bronchitis, bronchiectasis and asthma should be subjected to a careful roentgen examination of the sinuses. When tonsils and adenoids are present, he advises simultaneous irrigation of the antrums while the child is under anesthesia. Weekly roentgenographic studies after an acute attack are useful in determining whether the sinuses have entirely cleared. Lindsay finds it possible to use a local anesthetic when irrigating the antrums of children over 6 years of age. If the child is uncooperative, he finds it advisable to make a window in the antrum. The middle turbinate is occasionally amputated to improve drainage. During the past three years the use of a stock vaccine sprayed into the nose "has apparently resulted in a very definite decrease in the number of acute infections of the upper respiratory tract."

Ebbs <sup>62</sup> reports that an analysis of the results of postmortem examinations on 200 children dying of pneumonia revealed infected sinuses in 42.5 per cent. The incidence of bronchiectasis was high in this group. The histories revealed numerous attacks of bronchitis or bronchopneumonia. Illustrative case reports accompanied by photomicrographs of sections from the lungs and extensive references to the literature make the article worthy of study. The author emphasizes the importance of early diagnosis of bronchiectasis and removal of coincident disease in the sinuses. Chronic bronchiectasis is hard to cure. The sinuses must be cleaned out and the patient sent away to a convalescent home in a favorable climate. In all of 15 cases of bronchiectasis in the series the author found coexistent infection of the sinuses or ears.

McArthur <sup>63</sup> claims that the usual objections to radical operation on the antrum of children, namely, danger to the permanent tooth buds

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61 Lindsay, J. R. Chronic Sinusitis in Children, *Illinois M. J.* **71** 323 (April) 1937.

62 Ebbs, J. H. The Relation of Upper Respiratory Tract Infection to Early Bronchiectasis in Children, *Proc. Roy. Soc. Med.* **30** 1407 (Sept.) 1937.

63 McArthur, G. A. D. The Results of Radical Antrum Operations in Children, *M. J. Australia* **2**:470 (Sept. 18) 1937.

and unsatisfactory results with permanent invalidism, are not valid provided care is taken to make the opening sufficiently high and to avoid damage to the infraorbital nerve. Also one must be careful not to traumatize the soft tissues with the retractors and to remove the mucous membrane of the sinus completely. The records show that 40 patients under the age of 10 were operated on prior to 1931, 20 of whom were subsequently traced. The results were good in 13, fair in 3 and poor in 4. One patient had bronchiectasis and was relieved by an operation on the ethmoid sinus. Another had a chronic cough, the antrum was reopened, and an area of infected mucosa was discovered which was isolated by a band of fibrous tissue. Removal brought about relief from the cough and discharge, although the headache persisted. In 15 of the series a full complement of upper teeth developed. One patient reported a cuspid tooth missing.

Morgan<sup>64</sup> likes the term "bronchosinusitis" applied by Watson-Williams to sinusitis associated with bronchitis and is in favor of early operation on the affected sinus.

Rathbone<sup>65</sup> treated 70 children suffering from chronic disease of the sinuses by roentgen irradiation and compared late roentgenograms with those taken before the treatment was started. He found 57 per cent of the children cured, 28 per cent improved and 15 per cent not benefited. He considers this treatment ideal for patients with diffuse lymphoid hyperplasia throughout the nose and throat, a watery or mucous discharge, a history of frequent colds, a chronic cough and hyperplasia of the mucosa of the antrum or ethmoid sinus as demonstrated roentgenographically. He also recommends it for infants and young children with frequent colds, otitis media and enlarged glands who are too young for tonsillectomy. He feels that the treatment is perfectly safe and that it is an advantage to postpone tonsillectomy until the child is older. After roentgen treatment the adenoids shrink from 25 to 50 per cent. In one hospital Rathbone uses 125 kilovolts, 5 milliamperes, a distance of 12 inches (30 cm) and a 5 mm aluminum filter and gives 120 roentgens measured in air. At another hospital he uses 220 kilovolts, 20 milliamperes, a distance of 50 cm and a 0.5 mm copper filter and gives a dose of 100 roentgens. Three overlapping areas, 10 by 10 cm or 7 by 7 cm, are treated, one anterior area and a right and a left lateral area, depending on the size of the child. The eyes and eyebrows are protected with 1 mm lead shields, which are oval and of various sizes to fit the bony orbits. A small band of adhesive tape

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64 Morgan, B. The Relation of the Ear, Nose and Throat to the Diseases of Children, *Proc Roy Soc Med* **30** 1415 (Sept) 1937.

65 Rathbone, R. R. Roentgen Therapy of Chronic Sinusitis in Children, *Am J Roentgenol* **38** 102 (July) 1937.

across the nose holds the shields in place. Routinely six treatments are given, three a week for two weeks, only one area a day being treated in rotation with 100 or 120 roentgens, depending on available equipment. If cough is present, the chest is given 100 roentgens at the end of the treatments of the sinuses.

#### SINUSITIS IN RELATION TO DISEASES OF OTHER ORGANS

*Pulmonary Diseases*—Fox and Harned<sup>66</sup> present a résumé of their routine survey of asthmatic patients at the Illinois Research Hospital. The patients were admitted to the allergy department, where a complete physical examination was made. Laboratory tests included examination of the blood, urine and sputum, cutaneous tests, a determination of the basal metabolism, electrocardiographic study and roentgenographic study of the chest. The patients were then sent to the department of otolaryngology, where roentgenograms were made after the injection of contrast mediums and cultures and smears were made of material from the nose, throat and bronchi. Patients with a frank pathologic process in the sinuses were subjected immediately to such surgical intervention as was indicated. According to the authors, they make it a rule never to operate on a patient with a borderline infection. As a rule they perform a radical operation, if all the sinuses are involved, the Ferris-Smith or Sewell technic is employed. If the frontal sinuses are free, they do an intranasal operation on the ethmoid sinus and a Caldwell-Luc operation. The authors claim that irrigation washings which are sterile on culture do not prove the absence of bacteria, because in 25 such cases they removed pieces of tissue from the sinus which on staining with the Giemsa method and on animal implantations yielded mixed bacterial growths. Of 40 patients on whom total exenteration was done, 40 per cent were free from asthma for from six months to a year (considered failures) and 60 per cent had two or less attacks per year for five years and were able to carry on their work (considered cured).

Nonsurgical treatment depends on the type of infection, the age of the patient, the duration of the disease and the presence of pulmonary changes. Sixteen adults with pulmonary changes were given weekly instillations with 40 cc of iodized poppyseed oil for twelve weeks. The treatment was helpful but not curative. Twenty-four patients were given instillations of autovaccines beginning with 5 cc, the dose being doubled every four days until 40 cc was reached. A full course included 500 cc. Of this group, 16 per cent were free from asthma nine months or more and 50 per cent were relieved for six months. Other methods of treatment, such as injections of extracts from tissue removed at

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<sup>66</sup> Fox, N, and Harned, J. W. Treatment of Asthmatic Patients in Otolaryngologic Practice, Arch Otolaryng 25:393 (April) 1937.



operation, injections of serum from patients with asthma previously operated on and injections of pseudoglobulin, yielded negligible results

A series of 100 patients with chronic cough, nasal discharge or asthma were thoroughly studied by Davison,<sup>67</sup> 45 were found to be nonallergic. When there was a history of influenza or pneumonia, surgical treatment of the sinuses improved the nasal symptoms but did not cure the cough. The sinuses of many of the patients who were allergic showed various types of pathologic changes. Bronchiectasis was found alone in one third of the series, and in the author's opinion it was due to acute destructive pneumonia. The author is impressed with the necessity for thorough and complete diagnostic survey in all cases and emphasizes the importance as well as the difficulty in evaluating the endocrine and allergic factors.

Settel<sup>68</sup> states that practically all infectious diseases of the lower air passages are the sequence of infection higher up by reason of aspiration, muscular and ciliary action, neurogenic balance and lymphatic and ciliary pathways. In addition to evidence accumulated from the literature, the author offers the following supporting contentions, namely, the fact that the same pathogenic organisms found in the lower part of the respiratory tract are present in the upper air passages and also the fact that clinical improvement in the state of the former follows elimination of the bacteria in the latter.

Le Mee, Cler and Langeard<sup>69</sup> reported a case of bronchiectasis associated with maxillary sinusitis in a child of 2½ years before the Société de Laryngologie des Hôpitaux de Paris, which provoked considerable discussion. It was admitted that the connection between sinusitis and pulmonary conditions has not been stressed in the French literature to the degree that it has in the American, English and Italian literature, and the speakers, while conceding that there must be some connection between the two, could not agree on the question of cause and effect. It was suggested that anatomic or hereditary predispositions favored simultaneous development of infections in the two localities.

*Arthritis*—Hurd<sup>70</sup> finds infection of the sinuses most frequently associated with rheumatoid arthritis, occasionally of the mixed type and less often of the osteoarthritic type. The sinusitis associated with the first type is usually silent but when eliminated favors the cure of

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67 Davison, F. W. Chronic Sinusitis. Its Relation to Chronic Bronchitis, *Pennsylvania M. J.* **40** 821 (July) 1937.

68 Settel, N. Sequence of Infectious Diseases in the Upper and Lower Respiratory Tract, *N. Y. State J. Med.* **37** 1435 (Aug. 15) 1937.

69 Le Mee, Cler and Langeard. Sinusite maxillaire et dilatation bronchique, *Ann. d'oto-laryng.*, December 1936, p. 1280.

70 Hurd, L. M. The Nasal Accessory Sinuses as Foci of Infection in Arthritis, *M. Clin. North America* **21** 1683 (Nov.) 1937.

the arthritis. The pathologic process is most frequently located in the ethmoid sinus and is often associated with infection of the maxillary sinus and is usually of the hyperplastic type. Careful examination will show changes in the color and consistency of the middle turbinates which are significant of a pathologic process in the ethmoid sinus. The author advises operation when the following conditions are present: polypoid degeneration of the mucosa of the ethmoid sinus and roentgenographic evidence of osteitis or thickened mucosa. In such cases the operation should be radical. Also, one must not overlook allergy, vitamin deficiency and endocrine disturbances.

*Deafness*—Whiteman<sup>71</sup> treated 79 patients of all ages for various types of deafness (mostly catarrhal), with improvement of from 20 to 70 per cent in 70 per cent. He even claims to have obtained improvement in several genuine cases of otosclerosis. The patients were all treated in Australia but the author demonstrated his method on 3 of Prof. Hugo Frey's patients in Vienna and states that 2 of them showed definite improvement. According to this treatment, the patient is hospitalized for two weeks. A window is made in each antrum, the inferior meatal opening being made very large. Twice daily the antrums are irrigated with physiologic solution of sodium chloride. This is followed by the inhalation of menthol vapor. The patient is instructed how to pass a catheter into the sinus so that he may continue the irrigations at home. The author claims that the treatment stops the nasal discharge and dries the nasal passage, which results in improved hearing. The inhalations of menthol vapor must last a full hour and should be repeated frequently. (This treatment would have to be thoroughly controlled by careful audiometric examinations through various seasons before the results could be appraised.)

*Mental Disease*—Graves<sup>72</sup> found 1,425 of 1,881 patients examined at the Birmingham Mental Hospital to be suffering from disease of the sinuses. The antrums alone or in combination with other sinuses were affected in 1,148. He cites numerous cases showing how the discovery and drainage of a closed empyema or "occult" sinusitis resulted in relief from mental disorders. He points out that when a diseased sinus ceased to discharge, the symptoms of toxemia made their appearance. In some of the cases the disturbance came on some time after an attack of influenza, when all the nasal symptoms had subsided. He quotes Pickwith and Wright as having demonstrated cases in which only a diligent and persistent search for the focus led to its discovery, and whenever pus

71 Whiteman, R. J. *Neue Therapie für Schwerhörige*, Wien med. Wchnschr. 87:900 (Aug. 28) 1937.

72 Graves, T. C. *Nasopharyngeal Sepsis in 2,056 Cases of Mental Disorder, The Importance of Closed Sepsis*, Brit. M. J. 1:483 (March 6) 1937.

was found and eliminated the patient always recovered from the mental disorder (Not much is said about the type of mental disorder that was under investigation, although mention is made of psychoses and manias incorrectly diagnosed. Also there is no statement as to how many of the group mentioned were treated or operated on and what percentage were cured and how long the cure lasted.)

#### MALIGNANT TUMORS

Huizinga's<sup>73</sup> article is based on studies of 35 cases of malignant tumor of the nose and sinuses and deals with difficulties of diagnosis from both the clinical and the histologic aspect. One must always bear in mind when taking a specimen for biopsy that different portions of the tumor may present varying histologic pictures, so that it is impossible in some cases to obtain a clear picture of the true nature of the growth from only one section. This is particularly true of sarcomas, which may resemble a granuloma and vice versa. One case in point was that of a man of 60 with a tumor-like swelling near the internal angle of the eye, which on biopsy was twice diagnosed as giant cell sarcoma but which eventually was proved to be Paget's disease. In another case a tumor of the antrum was first diagnosed as squamous cell carcinoma with pearl formation, but a later biopsy specimen yielded tissue rich in cellular material of unusual polymorphous structure, and the diagnosis was changed to sarcoma. Later a third biopsy specimen was examined and a diagnosis of carcinosarcoma was made. At autopsy a thorough study of the region showed both types of tumor present. A rare case of lymphogranuloma of the antrum of a young girl is described in detail and reference is made to Graff's<sup>74</sup> interesting analysis of this not unusual type of growth. The author also calls attention to the difficulty of diagnosing erosion of the floor of the frontal sinus in malignant disease because of anatomic variations in this region and the uncertainty of roentgenograms.

Ohngren<sup>75</sup> presents a thorough analysis of his treatment of malignant tumors of the upper jaw as practiced at the Sabbatsberg Clinic and Radiumhemmet in Stockholm. From 1924 to 1936 he treated 235 patients. One hundred and twenty were followed for five years or more, and 35 per cent were found to be living without recurrence for periods of from five to twelve years. His method comprises thor-

73 Huizinga, E. Diagnostische Schwierigkeiten bei malignen Nasennebenhöhlentumoren, *Acta oto-laryng* **25** 296, 1937.

74 Graff, S. Ueber die bosartigen Geschwülste und geschwulstähnliche Neubildungen des Epipharynx, *Beitr z path Anat u z allg Path* **95** 497, 1935, *Atlas der Erkrankungen der oberen Luftwege*, Leipzig, Curt Kabitzsch, 1933.

75 Ohngren, G. Malignant Disease of the Upper Jaw, *J Laryng & Otol* **52** 18 (Jan) 1937.

ough destruction of the tumor with surgical diathermy by either a transfacial or a sublabial approach, depending on the location of the tumor and the presence or absence of involvement of soft tissue. A preliminary ligation of the external carotid artery is done in most cases, and all suspicious tissue is destroyed, even if it means removing the soft tissues of the cheek, the orbital contents, the nasal structures up to the cribriform plate and the tissues within the pterygoid fossa. This is followed by the use of high voltage roentgen therapy or of a radium bomb applied through several portals so as to obtain the maximum of cross fire. At Radiumhemmet high voltage roentgen therapy is used preoperatively and local irradiation postoperatively. The latter is applied within the wound for a total of from 500 to 2,000 milligram hours, the treatment is repeated at intervals of three months. As to metastases in the lymphatic glands, the author has found irradiation to yield better results when used alone than when combined with block dissection. Since the original operation may be prolonged, he prefers a combination of local anesthesia with administration of evipal or chloroform in order to spare the patient the pain which extensive electrocoagulation may produce.

The results obtained by Welch and Nathanson<sup>76</sup> were not as good. Of a series of 106 patients with carcinoma of the antrum treated prior to 1933, 25 per cent were dead within ten months, 50 per cent within seventeen months and 75 per cent within thirty-two months.

Del Regato<sup>77</sup> reports the results of an experiment at the Foundation Curie, in which 10 patients with epithelioma of the maxillary sinus were treated by high voltage roentgen therapy alone. The treatments were preceded by the extraction of all teeth. Four of the 10 patients were alive and free from the disease for periods of from five to fifteen years. The technic used was as follows: from 180 to 200 kilovolts, from 3 to 4 milliamperes, a skin distance of from 50 to 60 cm., with an average daily dose of from 150 to 200 roentgens per hour, and filtration with 2 mm. of copper and 3 mm. of aluminum. Two lateral fields of from 70 to 120 square centimeters, one anterior and one posterior, were treated, occasionally a third field on the opposite side was treated and if necessary an additional field to cover the glands. A total dose of from 4,000 to 8,000 roentgens was given slowly over a period of from five to six weeks. Radioepithelitis appears in from twelve to fifteen days, during which time the treatment is either lowered in intensity or is stopped temporarily.

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<sup>76</sup> Welch, C. E., and Nathanson, I. T. Life Expectancy and Incidence of Malignant Disease. II. Carcinoma of the Lip, Oral Cavity, Larynx and Antrum, *Am. J. Cancer* **31** 238 (Oct.) 1937.

<sup>77</sup> del Regato, J. A. Roentgentherapy in Epitheliomas of the Maxillary Sinus, *Surg., Gynec. & Obst.* **65** 657 (Nov.) 1937.

Schall <sup>78</sup> comments on the sequence of exophthalmos following irradiation of carcinoma of the antrum. Five patients were treated by electrocoagulation and local application of 100 mg of radium packed in gauze into the wound for a total of from 2,000 to 4,000 milligram hours. Interstitial irradiation with radon in needles was used in the cases in which the growth was inoperable. Exophthalmos was noted as early as twenty-four hours after the treatment and as late as several weeks and was accompanied by lacrimation, drying of the cornea and orbital pain. Frequently exenteration of the orbit is necessary to relieve the pain or when the ocular function is destroyed.

Daito <sup>79</sup> reports a case of sarcoma of the upper jaw involving the anterior, medial and inferior walls of the antrum. On account of repeated severe hemorrhage, the external carotid artery was ligated, and the author notes that after the ligation the histologic picture changed from that of a mixed round cell sarcoma to that of a small round cell sarcoma and the fever disappeared. The tumor was resected by a combined Denker and Partschi operation. Daito recommends complete surgical resection of the jaw only if the patient is seen early enough and the general condition is good. He therefore advises opening the sinus in all cases in order to determine the extent of the process before deciding definitely on the treatment to be followed.

Shebesta <sup>80</sup> reports a case of tumor of the upper jaw in a man of 33 in which the diagnosis of lymphosarcoma was not made until after death. The growth involved the antrum, the nasal cavity and the bones of the face, resulting in gangrenous breaking down of the soft tissues over the side of the nose and the adjacent cheek. The biopsy specimens yielded mostly round cells in an abundant stroma. Syphilis, rhinoscleroma and ulcerating granuloma were considered in the diagnosis. Autopsy revealed metastases in the glands and liver, which proved to be lymphosarcoma. (The photographs and descriptions of these cases tally closely with those of 2 cases of "granuloma gangrenescens" of the nose and jaw reported by Joisten <sup>81</sup> and of a similar case reported by Lewy <sup>82</sup>.)

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78 Schall, L. A. Exophthalmos Complicating Irradiation, *Tr. Sect. Laryng, Otol & Rhin., A. M. A.*, 1937, p. 98.

79 Daito, T. Ueber einen Fall von bösartigem Oberkiefersarkom, Unterbindung der Arteria carotis externa, Oto-rhino-laryng **10** 627 (July) 1937.

80 Shebesta, E. M. Gangrene of the Face Produced by Lymphosarcoma, *Radiology* **29** 33 (July) 1937.

81 Joisten, E. Zwei atologisch unklare Fälle von gangraneszierender Entzündung der Nase und des Oberkiefers, *Ztschr. f. Hals-, Nasen- u. Ohrenh.* **41** 105, 1936.

82 Lewy, A. A Case of Gangrenous Osteomyelitis of the Paranasal Sinuses, *Arch. Otolaryng.* **27** 91 (Jan.) 1938.

Collett, Charachon and Piaget<sup>83</sup> report the case of a woman of 53, edentulous since the age of 20, in whom a swelling of the cheek developed after a blow with the fist about six months previously. She complained of pains and inability to wear her plate. A soft swelling was palpable in the gingival fold, and roentgenographic examination after injection of iodized poppyseed oil showed a cystic mass filling the lower part of the antrum. At operation it was found that the cyst was completely enclosed with a thin bony covering. It was removed, and the sinus was opened. The cyst was filled with caseous material. Recovery ensued. Eighteen months later the patient returned with renewed pains and presented an ulcerated area in the alveolar recess, which bled freely. Biopsy showed a squamous cell carcinoma. The author speculates on the relation of the cyst to the carcinoma. He believes that the paradental cyst which had been long quiescent was incited to activity by the trauma and that the long-standing irritation and chronic sinusitis may have been the etiologic factors in the development of the carcinoma.

Fernandes<sup>84</sup> reports a cure of two and a half years' duration of an extensive carcinoma involving the maxillary, ethmoid and sphenoid sinuses and invading the overlying soft tissues of the cheek. The growth was completely exenterated, and the cavity was treated with radium (amount not stated), which was applied in five sessions. The histologic report was undifferentiated carcinoma—masses of cells in columns with little intercellular stroma and numerous mitoses.

Hill<sup>85</sup> points out the difficulties of treating malignant disease of the sinuses and nasopharynx in the small hospital away from a large medical center. The patient is often financially unable to make a trip away from home. The greatest difficulty lies in the lack of expert laboratory facilities for studying biopsy specimens. Also beginning growths are frequently overlooked. Several illustrative cases are cited. The author favors electrocoagulation followed by intensive irradiation. In cases of involvement of the antrum, one must disregard the cosmetic result in order to treat the lesion adequately.

A case of melanosarcoma invading the nasal passages, the antrum and the ethmoid sinus is reported by Cho<sup>86</sup>. The patient was a woman of 37, and the growth manifested itself by nasal obstruction and hemo-

83 Collet, F. J., Charachon, J., and Piaget, F. Kyste du sinus maxillaire suivi d'un épithélioma du maxillaire supérieur, *J. de med. de Lyon* **18** 405 (July 20) 1937.

84 Fernandes. Epithélioma des fosses nasales opéré et irradié guéri depuis 2½ ans, *Bull. Soc. belge d'oto-l, rhin, laryng.*, 1937, p. 58.

85 Hill, F. J. Malignant Disease of the Sinuses and Nasopharynx in the Small Hospital, *Ann. Otol., Rhin. & Laryng.* **46** 158 (March) 1937.

86 Cho, K. Ein Fall von disseminierten Melanosarkomen in der Nasenhöhle, *Oto-rhino-laryng.* **10** 910 (Oct.) 1937.

rhages. The patient recovered, but the German abstract fails to give the details of the therapy employed.

Another interesting report in the Japanese literature is that of Amano<sup>87</sup>. A primary carcinoma of the ethmoid sinus developed in a boy of 14. The tumor extended in the beginning over the region of the right angulus internus, so that the patient sought advice from an ophthalmologist. A diagnosis of dacryocystitis was made, and dacryocystotomy was performed. As there was no improvement, the patient was sent to the hospital, where in spite of postoperative radium treatment he died. A diagnosis of carcinoma was then made, but the exact histologic type is not given.

Garschin<sup>88</sup> reports a case of primary "carcinoma gelatinosum" involving the frontal sinus, an extremely rare condition. The patient was a man of 74, who was treated for suppuration of the right frontal sinus and had had a number of polyps removed some time previously. Exophthalmos and paresis of the abducens nerve prompted an external operation, at which time the tumor mass was discovered, invading both the frontal and the ethmoid sinus.

Another case of primary carcinoma of the frontal sinus is reported by Casteran and Achotegui<sup>89</sup> in a man of 49 who gave a history of having sustained a blow over the left frontal region six months previously which raised a lump, the swelling disappeared in fifteen days. Three months later the patient noticed that the upper border of the orbit was becoming thick and tender and causing a narrowing of the palpebral fissure. An irregular lobulated swelling was found at the outer third of the supraorbital margin, displacing the eye slightly. The overlying skin was adherent. Roentgenograms showed a dense shadow of the internal portion of the frontal sinus and some blurring of the external and the upper margin of the sinus. Operation disclosed absorption of the bony margin and a perforation of the anterior wall of the sinus. The orbital wall was absorbed, and the tumor was pressing directly on Tenon's capsule, also the dura was exposed but was not adherent. The mass was easily extirpated. It proved to be an epithelioma, partially cylindromatous. The authors comment on the lack of subjective symptoms and state that the diagnosis could be made only after histologic study. They are sure that trauma was the exciting cause.

87 Amano, B. A Case of Primary Ethmoidal Cancer in a Juvenile, *Bull. Nav. M. A., Japan* **26** 38 (May 15) 1937.

88 Garschin, M. I. Zur Frage über primären Krebs der Stirnhöhle, *Vestnik otol.*, 1937, p. 121.

89 Casteran, E., and Achotegui, M. Epithelioma primitivo del seno frontal, *Rev. argent. de oto-rino-laring.* **6** 281 (July-Aug.) 1937.

A third case of malignant tumor of the frontal sinus is reported by Alexandre<sup>90</sup> His patient was a woman of 43 with an indolently growing tumor over the eyebrow, observed over a period of twelve years Recently the growth began increasing It was extirpated and found to be an encapsulated, bloody, friable, grayish-yellow growth invading the frontal bone and growing into the sinus, which was greatly enlarged and encroached on the orbit The dura was exposed rather widely The patient was given postoperative irradiation Histologic examination revealed a hemangiomaendothelioma with a tendency to psammomatous changes The growth was evidently primary in the bone, with secondary invasion of the sinus cavity There was no recurrence up to two years

#### NONMALIGNANT TUMORS

*Cyst*—Rosedale and Koepf<sup>91</sup> report 7 cases of cyst of the maxilla, 6 of which encroached on the antrum One was complicated by an osteoma and another contained several teeth Supernumerary teeth were found in 2 cases Some of the cysts were large, and 3 were bilateral Two became manifest after extraction of teeth and 2 were associated with carious teeth The other 3 were of the follicular type The authors find Hartwig and Mallassez's explanation of the origin of these cysts inadequate, since the inclusion of epithelial rests does not fully account for the fluid content which reappears rapidly after experimental evacuation Also, they find no reasonable explanation to date of the mechanism of cystic formation They distinguish radicular from follicular cysts by the fact that the former are always associated with apical granulomas and are therefore the result of preexisting disease about the root of a tooth, whereas the follicular cyst, otherwise known as a dentigerous cyst, is associated with second dentition and may be suspected from "defects in the dental arch due to unerupted or supernumerary teeth" Follicular cysts may contain unerupted teeth, whereas radicular cysts never do

Bass<sup>92</sup> reports 2 cases of dentigerous cyst The first case was that of a girl of 19 An upper third molar was extracted and found to have perforated the antrum The latter was dark Irrigations cleared up the condition, and the patient was well for eight years A nasal discharge then appeared with dull pain in the cheek Pus was found on irrigation, and roentgen examination showed the sinus to be dark with

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90 Alexandre, A · Un caso di emangioendotelioma dell'osso frontale a sviluppo endosinusale, *Tumori* 11:493, 1937

91 Rosedale, R S, and Koepf, S W Nontumorous Cysts of the Maxilla · Interesting Cases and Discussion, *Ann Otol, Rhin & Laryng* 46:652 (Sept.) 1937

92 Bass, A L · Dentigerous Cyst, with Report of Two Cases, *Kentucky M J* 35:312 (July) 1937.



a curved shadow, as of a cyst with erosion of the lateral inferior wall. A Caldwell-Luc operation revealed a bony cyst involving the entire antrum. The second case was that of a child of 4 with swelling of the cheek for two years and a cloudy antrum. The distribution of the unerupted teeth was universal. Operation was performed by the sublabial route, and a cyst was exposed and peeled out. Three unerupted teeth were found widely displaced. One was in the canine fossa, 1 in the posterior wall of the antrum and the third in the lateral nasal wall below the inferior turbinate.

Falcao<sup>93</sup> reports a case of a boy of 4 who was kicked in the face by a horse, sustaining a fracture of the upper jaw. At his second dentition the teeth erupted irregularly. At the age of 12 it was noticed that there was a fistula in the gingiva of the opposite side, from which pus discharged. Roentgen examination showed both antrums to be dark, there was also an ectopic canine tooth in the superointernal angle of the maxilla. Operation revealed destruction of the anterior wall of the antrum, which was filled by a cyst containing a foul, fungating material. The unusual features of this case were (1) the atopic position of the canine tooth, which was not within the cyst cavity itself; (2) the fact that the cyst though of dental origin was not a true follicular cyst, and (3) the development of the cyst in an unusual location, namely, the frontal process of the maxilla.

Tabet and Dayde<sup>94</sup> claim that a dentigerous cyst developing at the expense of the third molar is comparatively rare. In the case reported by them the cyst grew into the antrum and became infected through contact with the root of a carious first molar, which gave rise to symptoms leading to its discovery and removal.

*Mucocele and Pyocele*—In the reports of the past year every paranasal sinus has been described as the seat of a mucocele.

Williams<sup>95</sup> reports a case in which an unusually large mucocele eroded the cribriform plate and the posterior wall of the frontal sinus. A drainage tract was provided as follows:

" mucus membrane overlying the roof of the nose was incised from before backward up to the posterior ethmoid region and the under surface of the flap was denuded of its mucous membrane as were the upper part of the nasal septum and the lateral wall of the nasal cavity above and on the middle turbinate. The flaps were then packed down against the septum and the lateral wall of the nose with a vaseline pack "

93 Falcao, T. Sinusite maxilar cronica, canino ectopica e cisto dentigero, Rev oto-laring de São Paulo 4 1049 (Nov-Dec) 1936.

94 Tabet, G., and Dayde, G. Kyste dentifere du maxillaire superieur a developement sinusien, Ann d'oto-laryng, May 1937, p. 398.

95 Williams, H. L. Mucocele of the Left Frontal Sinus. Report of Cases with Rise of Flap of Mucous Membrane to Maintain Patent Duct, Proc Staff Meet, Mayo Clin 12 665 (Oct 20) 1937.

The pack was removed in twenty-four hours, and recovery ensued, with minimum scarring

Nakashima <sup>96</sup> reports a case of typical mucocoele of the ethmoid sinus, causing exophthalmos and diplopia. The mucocoele had been known to be present for fourteen years and was incised and drained a year previous to its complete removal.

In Wildenberg's <sup>97</sup> case the eyeball was displaced downward, forward and outward. There was diplopia, and roentgenograms showed a large opaque frontal sinus, the intersinus septum was destroyed, and the crista galli was pushed backward and outward. Removal of the growth necessitated taking away the entire anterior wall of the frontal sinus and exenterating the ethmoid labyrinth. A marked deformity resulted.

Csillag <sup>98</sup> reports a case of mucocoele of unusual interest in that the patient had papilledema with tortuous dilated retinal veins and extreme reduction of vision. The mucocoele was found to have eroded the orbital wall as well as the posterior wall of the sinus, exposing a large area of dura. It was also found to have extended far backward into the orbit, displacing and compressing the optic nerve. Removal of the tumor was followed by disappearance of the fundus changes and a marked gain in visual acuity.

Kecht <sup>99</sup> reports a case of mucocoele involving both ethmoid sinuses. The septum was eroded clear through, and the dura was exposed. There was no connection with the frontal sinus, as proved by the injection of iodized poppyseed oil. External operation was followed by convulsions and coma, which were relieved after the packing was removed. The author claims to have found only 3 similar cases reported in the literature (Mackenty, Flath and Adelheim and Moure). It is likely that the condition in the author's case originated in one ethmoid sinus and grew through the septum into the opposite ethmoid sinus, since there was a history of an endonasal operation about twenty years previously.

Ichikawa's <sup>100</sup> patient, a woman of 56, had a slight swelling at the internal angle of the orbit for about a year which began to increase in size, accompanied by exophthalmos and neuralgic pains. The lid was incised twice, without much benefit. Roentgen examination showed a

96 Nakashima, M. Ueber die Mucocoele der Siebbeinzellen, *Oto-rhino-laryng.* **10** 918 (Oct) 1937

97 van den Wildenberg, L. Volumineux mucocèle du sinus frontale, *Bull. Soc. belge d'oto-l., rhinol., laryng.*, 1937, p. 47

98 Csillag, F. Unusually Large Mucocoele of Frontal Sinus Causing Severe Impairment of Vision, *Budapesti orvosi ujság* **34** 830 (Oct 1) 1936

99 Kecht, B. Ein seltener Fall von Mucocoele (Pyocoele) beider Siebbein-labyrinthe, *Arch. f. Ohren-, Nasen- u. Kehlkopfh.* **143** 330, 1937

100 Ichikawa, J. Ein Fall von Siebbeinpyocoele, *Oto-rhino-laryng.* **10** 430 (May) 1937

large cystic cavity in the region of the ethmoid sinus. The secretions contained staphylococci. The mucosa of the middle meatus and turbinate was swollen and polypoid. External operation was followed by disappearance of all symptoms.

Mucocele of the maxillary sinus is unusual. Lopes<sup>101</sup> states that he could find only 15 cases reported in the literature. His patient complained of pain in the cheek. An upper molar tooth was extracted, but the pain continued. Roentgen examination showed a large elliptic shadow almost filling the antrum. The nasointernal wall was pushed medially almost to the septum. Operation disclosed a cystic mass containing a thick chocolate-colored material filling the antrum. The facial wall was absorbed down to paper thinness, and the orbital wall was eroded over an area of 2 square centimeters. The mass came out with the entire mucosa, which stripped off easily. The walls of the cyst consisted of thick fibrous tissue, which was lined with typical mucosa.

Fornari<sup>102</sup> reports a case of mucocele of the sphenoid sinus occurring in a man of 22, who complained of nasal block. There was a reddish mass filling one side of the nose, which seemed to come from high up and looked like a sarcoma. Attempts to secure a biopsy specimen resulted in rupture of a mucocele and discharge of a large amount of dark fluid. Probing led directly into the interior of the sphenoid sinus, which was very roomy. The probe entered to a depth of 8.5 cm from the nasal spine. The entire anterior wall and part of the floor of the sphenoid sinus had been eroded. The author is certain that the growth could not have originated from the ethmoid sinus, because pressure sufficient to absorb the anterior wall of the sphenoid sinus would have caused encroachment on the orbit, which was not the case in this instance.

*Fibroma*—Arons<sup>103</sup> reports a case of fibroma in a boy of 11 who had two teeth removed because of a swelling of the cheek. Histologic examination of tissue attached to one root led to the diagnosis of osteosarcoma. With a radium mold 6,000 milligram hours of treatment was given. The patient also received eight injections of a mixture of erysipelas and prodigious toxins, beginning with 1 minim (0.06 cc) and increasing to 8 minims (0.5 cc). Two months later he was given a cycle of roentgen irradiation of twelve treatments to three fields, 200 roentgens per treatment, for a total of 2,400 roentgens and nine additional doses of the toxins, beginning with 2 minims (0.12 cc) and

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101 Lopes, O. Mucocele do seio maxilar, Rev. brasil. de cir. **6**: 29 (Jan) 1937.

102 Fornari, G. B. Sulla patogenesi del mucocele del seno sfenoidale om. descrizione di un nuovo raro caso, Arch. ital. di otol. **49**: 315 (June) 1937.

103 Arons, I. Ossifying Fibroma. Case Successfully Treated with Irradiation, Am. J. Cancer **29**: 551 (March) 1937.

increasing up to 16 minims (1 cc) Ten years later the patient was still free from evidence of the growth A review of the case at this time proved that the neoplasm was a true ossifying fibroma and not a sarcoma

Manci's<sup>104</sup> patient a woman of 37 gave a history of a slowly growing tumor of the upper jaw over a period of ten years Caries of several teeth led to their extraction The tumor presented over the cheek and mouth and the buccoalveolar fold and the alveolar process in the region of the extracted molar Biopsy revealed a fibroma Radium therapy was tried but yielded no results The tumor was then excised through a transfacial incision It was found to extend from the palate up to the floor of the orbit and medially to the nasal wall Inferiorly it was covered only by the mucosa of the palate

*Antral Polyp*—Oppikofer<sup>105</sup> reports 2 cases of antral polyp The growths were large and pedunculated extending to the posterior choanae and showing gangrenous changes due to torsion of the pedicle In 1 case a Caldwell-Luc operation demonstrated the origin of the growth on the lateral wall of the sinus the pedicle stretching across the antrum through the enlarged ostium The polyp in the second case was removed by a intranasal application of a snare The polyp in the first case measured 13.5 cm in length It was an interesting specimen with a narrow pedicle the nasal portion shaped by pressure of the turbinate and septum a globular nasopharyngeal portion a narrow twisted portion and finally the gangrenous pharyngeal part which was bilobulated

*Chondroma*—Menne and Frank<sup>106</sup> report a case of so-called chondroma of the ethmoid sinus and by careful study and a review of the literature show that in many instances a growth of the type heretofore reported as primary chondroma of the ethmoid sinus really arises from the septum and invades the sinus secondarily The error arises from the fact that the growth is not diagnosed in most cases until it has attained such a size that it is frequently impossible to tell exactly at what point it originated The authors made a thorough roentgenographic investigation in their case and studied the growth at autopsy The growth occurred in a man of 41 developing over a period of several years and attaining such large proportions as to displace both eyeballs widely It invaded the orbits the palate the nasopharynx the cribriform plate and the cranial cavity When the patient was first seen

104 Manci F Fibroma del seno mascellare Ann di laring otol **37** 1 1937

105 Oppikofer E Jr Ueber Kreislaufstörungen in Retronasalpolypen insbesondere über die Gangrän durch Stieldrehung Ztschr f Hals- Nasen- u Ohrenh **41**:399 1937

106 Menne F R and Frank W W So-Called Primary Chondroma of the Ethmoid Arch Otolaryng **26**:170 (Aug) 1937

the growth might have been operable, but at that time the diagnosis was in doubt. Later when the patient reappeared in the clinic, the mass was of such magnitude as to exclude any consideration of operation.

Rubaltelli<sup>107</sup> reports the successful removal of a chondroma of the ethmoid sinus measuring 3.5 by 3 cm. The operation was done through a Citelli incision, which is similar to the Moure operation except that the incision is carried upward along the side of the nose to the supero-internal angle of the orbit and if necessary may be extended along the supraciliary ridge. This approach affords access to the nasal cavity, the maxillary sinus, the ethmoid sinuses and the sphenoid sinus. In the particular case reported, the cosmetic result was excellent, as the photographs testify.

*Osteoma*—The growth in Pieri's<sup>108</sup> case originated in the frontal sinus and invaded the orbit. The mass occupied the entire enlarged sinus and weighed about 100 Gm. Its removal entailed great difficulties and had to be done in two sessions, since the patient was doing poorly under the anesthetic at the first operation. The author believes that osteoma is caused by a renewed activity of the embryonal elements of the periosteum and fibrous tissue induced by trauma.

Marzio<sup>109</sup> favors the theory of Lagrange and Borst, although he admits that the etiologic factors may vary with the individual case. He reports 4 cases, in 2 of which the growth involved the posterior wall of the frontal sinus, exposing the dura. The growth in 1 case was complicated by a mucocele, and that in another was associated with chronic frontal sinusitis.

Lejeune-Laoureux's<sup>110</sup> patient, a man of 37, gave a history of acute frontal sinusitis ten years previously but no history of trauma. He complained of severe pains in the head for two weeks and swelling of the upper lid. Movements of the eyeball were unimpaired, and there was no impairment of vision. At operation the tumor was revealed lying just below a thin external plate of the sinus. It was ivory-like in color and texture and invaded the opposite sinus as well as the orbit. It was released with a chisel and removed in two fragments. Its attachment was found to be the inferoposterior angle of the sinus. It measured 5 by 1.5 cm and weighed 15 Gm. Externally it was dense, but internally it was composed of spongy bone.

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107 Rubaltelli, E. Contributo al metodo centro-facciale di Citelli nel trattamento dei tumori del naso, *Arch. ital. di otol.* **49** 64 (Feb.) 1937.

108 Pieri, P. F. Osteoma gigante del seno frontale di destra con invasione dell'orbita, *Valsalva* **13** 119 (March) 1937.

109 Marzio, Q. Tumori dell'orbita, osteoma orbito-fronto-etmoidale, *Riv. oto-neuro-oftal.* **13** 393 (Sept.-Oct.) 1936.

110 Lejeune-Laoureux. Observation personnelle d'un cas d'osteome du sinus frontal, *Bull. Soc. belge d'otol., rhin., laryng.*, 1937, p. 122.

Von Eicken and Schürmann<sup>111</sup> report a case in which a bony tumor was removed from the frontal sinus in 1915 and the patient was free from symptoms until two years before the case was reported. He complained of attacks of pains in the ear culminating in the reappearance of the growth, causing the eye to be displaced downward and outward. At operation it was found to involve the frontal and ethmoid sinuses exposing a large area of dura. There was considerable hemorrhage during the operation as well as at subsequent dressings. Histologic examination revealed a nodular mass covered with epithelium. The mass consisted of papillomatous components showing layers of bone laid down concentrically in the subepithelial spaces. It is the contention of the authors that the condition was primarily a papillomatous growth and that the osteoid formation was due to the influence of the epithelium on the indifferent young connective tissue stroma. They claim that the tumor was not a true osteoma but an 'organoid mixed tumor' and refer the reader to a thesis on this subject by Hertner for further details concerning the histologic picture.

*Miscellaneous.*—Michl<sup>112</sup> reports a case in which an adenoma filled the frontal sinus and was removed by an external operation but the patient died of a heart attack. He also reports a case in which a blastoma involved both frontal sinuses and exposed the dura; operation was successful. His third case was that of a simple granuloma causing the same symptoms as a true neoplasm; operation was also successful.

Coates<sup>113</sup> reports a rare case of cholesteatoma of the frontal sinus in a man of 51, who gave a history of trauma at the age of 15 which left him with displacement of the eyeball downward and outward, external strabismus and diplopia when corrective glasses were not worn. During the World War he suffered repeated attacks of swelling, redness and pain about the eye. In February 1936 an acute infection developed from exposure which resulted in a deep orbital abscess. It was drained by an incision through the lid. Subsequent operation on the frontal sinus disclosed a large cholesteatoma eroding the anterior wall, floor and posterior wall of the sinus. The material removed consisted of a 'whitish gray mass which shelled out easily almost intact. It was arranged in concentric layers. The matrix was thin.' Coates cites various authors to show that cholesteatoma in this region must be primarily due to fetal inclusion of epidermal tissues although in his case

111. von Eicken, C., and Schürmann, P. Zur Klinik und pathologischen Anatomie der knochenhaltigen gutartigen Gewächse der Nebenhöhlen, *Ztschr. f. Hals-, Nasen- u. Ohrenh.* **41**:291, 1937.

112. Michl, R. Tumors of the Frontal Sinus, *Časop. lék. česk.* **76**:967 (June 11) 1937.

113. Coates, G. M.: Cholesteatoma of the Frontal Sinus *Arch. Otolaryng.* **26**: 29 (July) 1937.

it was not at all improbable that the epidermal inclusion might have been due to trauma

Gutierrez <sup>114</sup> removed a dermoid cyst from the frontal sinus of a man of 23. The tumor had been present for five years as a small hard mass which caused no symptoms, until it suddenly began to increase in size and give rise to a feeling of weight. Roentgen examination after the injection of iodized poppyseed oil showed that the mass was encroaching on the sinus cavity and the orbit. It was removed through an external incision and was found to be secondarily infected, probably because of contact with the sinus mucosa.

Wattles <sup>115</sup> reports a rare case of benign giant cell tumor of the ethmoid sinus in a man of 21. There was a history of trauma, and the first diagnosis was mucocoele. The mass was removed through an external incision and was found to have eroded into the orbit as well as superiorly, exposing the dura. Histologic examination showed cells of three types, spindle, round and giant cells. The spindle cells made up the bulk of the tissue. The growth was markedly vascular, and there were large cystlike spaces containing both normal and broken-down red cells. Among the masses of spindle cells were many small spicules of new bone, all healthy. This is a characteristic finding in such tumors but is not always demonstrable. The giant cells were found near the periphery and were large with clear cytoplasm, taking a basic stain and containing many large darkly staining nuclei in the center. No mitotic figures were seen. The tumor has been known since 1845, when it was first reported by Pare and Lebert, but the classic description of it was written by Nelaton in 1860. A review of the literature reveals only 7 cases reported involving the ethmoid sinuses in the period from 1860 to 1935. The other bones of the body are more frequently affected by this growth than are the bones of the skull. There is a history of trauma in 64 per cent of the cases. It is assumed that they develop from the centers of ossification of cartilage bone. They are benign in their course and do not recur after surgical excision.

Bryant <sup>116</sup> reports a case in which a cystic mass enclosed in a thin bony capsule filled the maxillary sinus and appeared to originate in front of the third molar. There was a history of extraction of the second

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114 Gutierrez, A. Quiste dermoideo supurado de la region frontal en comunicacion con el seno frontal, *Bol y trab de la Soc de cir de Buenos Aires* **21** 795 (Sept 22) 1937.

115 Wattles, M. A Case of Benign Giant Cell Tumor of the Ethmoid Labyrinth with a Review of the Literature, *Ann Otol, Rhin & Laryng* **46** 212 (March) 1937.

116 Bryant, B. L. An Unusual Tumor Involving the Maxillary Antrum, *Arch Otolaryng* **25** 581 (May) 1937.

upper molar on the left side four years before without complications. A swelling developed about two years later and disappeared spontaneously after several weeks, recurring four months before the reported examination. It was incised and drainage persisted. The author discusses the differential diagnosis between true adamantinoma and radicular cyst, and in the case cited inclines to the diagnosis of the former because of the presence of a definite thin bony capsule.

*(To be concluded)*



## News and Comment

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### AMERICAN CONGRESS OF PHYSICAL THERAPY AND AMERICAN OCCUPATIONAL THERAPY ASSOCIATION

The seventeenth annual scientific and clinical session of the American Congress of Physical Therapy will be held cooperatively with the twenty-second annual convention of the American Occupational Therapy Association, Sept 12, 13, 14 and 15, 1938, at the Palmer House, Chicago. Preceding these sessions, on September 7, 8, 9 and 10, the congress will conduct an intensive instruction seminar in physical therapy for physicians and technicians.

The convention proper will have numerous special program features, a variety of papers and addresses, clinical conferences, round table talks and extensive scientific and technical exhibits.

The instruction seminar should prove of unusual interest to every one interested in the fundamentals and in the newer advances in physical therapy. The faculty will be comprised of experienced teachers and clinicians, every subject in the field of physical therapy will be covered. Information concerning the convention and the instruction seminar may be obtained by addressing the American Congress of Physical Therapy, 30 North Michigan Avenue, Chicago.

# Abstracts from Current Literature

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## Ear

STREPTOCOCCUS MENINGITIS F. COONLEY, New York State J. Med 37:573 (March 15) 1937.

Two recoveries from streptococcic meningitis are reported. One of these was in a girl 11 years of age. Meningitis followed acute mastoiditis and a pure growth of *Streptococcus haemolyticus* was obtained from the spinal fluid. All blood cultures were negative. Erysipelas streptococcus antitoxin was used both intramuscularly and intraspinally. In the second case, that of an adult, the streptococcus was not found in the spinal fluid.

AIKMAN, Rochester, N. Y. [AM. J. DIS. CHILD]

STREPTOCOCCAL MENINGITIS FOLLOWED BY RECOVERY J. McQ. THOMAS Proc. Roy. Soc. Med 30:411 (Feb) 1937

A boy of 7 years had had scarlet fever followed by otitis media in April 1935. Paracentesis on the right side and incision of a postauricular abscess on the left side were performed. Thereafter he had paralysis of the left side of the face. In the middle of September he was admitted to the hospital because of vomiting, fever, drowsiness and earache for the preceding three days. At the beginning of October cortical mastoidectomy was performed on the right side. Ten days later cortical mastoidectomy was performed on the left side, but no pus was found in the antrum. Lumbar puncture showed turbid fluid under normal pressure. Culture showed no growth. There were 6000 cells per cubic millimeter and most of them were polymorphonuclears. A week later a few gram-positive diplococci were found. A derivative of sulfanilamide, prontosil (the hydrochloride of 4-sulfamido-2,4'-diaminobenzene) was given 2 tablets three times a day. The temperature fell and the symptoms disappeared. The administration of the drug was continued for one week. A month later lumbar puncture revealed normal fluid under normal pressure. The Wassermann reaction of the fluid was negative.

WILLIAMSON New Orleans [AM. J. DIS. CHILD]

ABSCESS OF TEMPORAL LOBE OF OTITIC ORIGIN CURED BY PUNCTURE AND WIDE DECOMPRESSION C. VINCENT, M. DAVID and H. ASKÉNASY, Rev. d'oto-neuro-ophth. 15:81 (Feb) 1937.

It has been shown by Vincent, David and Askénasy (*Rev. d'oto-neuro-ophth.* 14:593 1936) that it is possible to cure certain encapsulated abscesses of the brain by removal en masse without drainage and that encapsulation can be favored by preliminary puncture and wide decompression. The case reported demonstrates that when the condition is in certain acute stages decompression and puncture alone may effect a cure. The patient, aged 8 years, experienced a progressively increasing syndrome of intracranial hypertension two weeks after purulent otitis of the right ear. Seven weeks after beginning of the otitis operation revealed a nonencapsulated abscess of the temporal lobe, with extensive collateral edema. Evacuation of the pus by puncture without incision of the dura, combined with wide decompression caused such rapid and complete disappearance of the symptoms that it seems warranted, more than ten months after the intervention, to anticipate a definite cure. The authors believe that if in certain cases, puncture of the abscess and decompression transform a subacute into a chronic, encapsulated abscess which may subsequently be removed en bloc, a similar technic is capable in certain other cases of effecting a cure rapidly and more simply by causing resorption of the

inflammatory focus without the necessity of capsule formation. The difference in the evolution of an abscess after decompression is due in large part to a difference in the virulence of the causal micro-organisms. In the case reported the infecting organisms were the staphylococcus and the streptococcus. Cerebral edema was responsible to a greater degree than the purulent collection for the intracranial hypertension. The treatment of cerebral abscess must embrace not only evacuation of the pus but, especially, control of the edema.

DLANIS, San Diego, Calif [ARCH NEUROL & PSYCHIAT]

VALUE OF ANISOCORIA IN DIAGNOSIS OF OTITIS MEDIA IN INFANCY. S. JANNUZZI, *Pediatrics* 45 39 (Jan) 1937

Jannuzzi describes at length an acute sympathetic syndrome of infection of the middle ear in children.

In his report he presents only 2 cases in which spontaneous anisocoria was shown, in the remaining cases the pupillary inequality had to be demonstrated by means of drugs. In the majority of cases he revealed miosis of the eye on the side of the affected ear, and in 2 cases he met with mydriasis. He feels that an inflammatory or a destructive process of the middle ear can provoke excitability or destruction of the sympathetic fibers that run in the middle ear and states that this sign is helpful in the diagnosis of otitis in children.

PAUMIRI, Brooklyn [AM J DIS CHILD]

OTITIS MEDIA IN NURSINGS. V. TRSAK, *Časop lek česk* 74 1258 (Nov 8) 1935

The author feels that a daily aural examination should be given infants with dietary disturbances, even in the absence of any symptoms referable to the ear. Collapse of the upper part of the posterior auditory wall speaks for a purulent infection of the antrum auris. A temperature of over 38.5 C (102.5 F) in the presence of purulent otitis in an infant is regarded as an indication for paracentesis, and if there is no tendency to healing after three weeks of discharge, mastoidectomy is recommended. In bilateral otitis immediate paracentesis of both drums is recommended. In bilateral mastoiditis the side more severely affected should be operated on first, the more mildly affected side may clear spontaneously. Bilateral mastoidectomy may involve too severe an operative shock for some subjects. In the presence of poor hygienic environment the combination of otitis with nasopharyngitis and dyspepsia may be frequent and severe.

STUIK, Chicago [AM J DIS CHILD]

OTITIS AND TOXICOSIS IN INFANTS. A. TEN BOKKEL HUININK, *Nederl tijdschr v geneesk* 80 4874 (Oct 31) 1936

A girl of 4½ months showed acute dyspepsia and high fever for six days. Her general condition was bad. The blood was highly toxic. Repeated paracentesis, performed without proper indication, had no result. As the condition was hopeless, both antrums were opened, mucopus with diplococci was found on both sides. Three hours later undisturbed recovery began. The author observed 10 analogous cases. In each case the desperate condition of the child justified the mastoid operation. Recovery took place in 6 cases.

VAN CREVELD, Amsterdam, Netherlands [AM J DIS CHILD]

## Pharynx

A COMPARATIVE STUDY OF HEMOLYTIC STREPTOCOCCI ISOLATED FROM THE THROATS OF RESIDENTS OF NEW ORLEANS AND NEW YORK. P. TEIGER and B. C. SEEGAL, *J Bact* 32 631 (Dec) 1936

The authors state that a study of the geographic distribution of rheumatic fever, scarlet fever and acute glomerulonephritis in Canada and the United States

has shown that two of these three diseases, rheumatic fever and scarlet fever, diminish in frequency in the South, while acute nephritis remains approximately as frequent in the South as in the North. Since clinical and laboratory data indicate that acute glomerulonephritis is usually initiated by an infection with hemolytic streptococci, it appeared peculiar that the incidence of this disease failed to diminish in the southern part of the United States while the incidence of the other two diseases due to hemolytic streptococci did decrease.

A series of cultures was obtained of material from the throats of patients with acute nephritis and acute pharyngitis and from normal persons (controls) living in New Orleans, and 63 strains of hemolytic streptococci were isolated. These were brought back to New York and compared with 103 strains isolated in cultures of material from the throats of patients in the city of New York. The organisms were examined for their fermentation of lactose, mannitol and salicin, their hemolysis in blood pour plates, their production of a soluble hemolysin and skin toxin, their hydrolysis of sodium hippurate and their final  $p_H$  in dextrose broth. In these tests no difference was found between the hemolytic streptococci isolated from the throats of residents of New Orleans and of New York.

STOESSER, Minneapolis [AM J DIS CHILD]

RETROPHARYNGEAL ABSCESS L. RICHARDS, New England J Med **215** 1120 (Dec 10) 1936

Richards reports a series of 162 cases of retropharyngeal abscess observed at the Children's Hospital in Boston during the past ten years. The fatalities numbered 12, or 7.4 per cent. The oldest patient was 12 years of age, the youngest, 4 months. By far the greatest number of patients were between the ages of 6 months and 3 years. Previous illnesses included sore throat in 22, otitis media in 21, cervical adenitis in 46 (glands previously incised in 8), head colds in 26, tuberculosis in 2, unexplained fever in 16, measles in 3 and nephritis in 1. The chief complaints included dyspnea (noisy breathing, snoring, cyanosis) in 61, dysphagia (regurgitation, anorexia, refusal) in 59, swollen neck in 37, stiff neck in 31, sore throat in 9, fever in 27, cough in 3 and convulsions in 2.

The retropharyngeal abscess merged with the preceding condition, but, on an average, the symptoms due to the retropharyngeal abscess were of about four days' duration. Inspection and palpation of the throat were the two major methods of examination, yet both palpation and inspection have resulted disastrously in more than one able operator's experience. Except in cases of dire urgency a lateral roentgenogram of the neck should be used instead.

The treatment for retropharyngeal abscess is drainage which is accomplished by an incision made internally through the posterior pharyngeal wall or externally through the soft tissues of the neck. The operative procedures in this series included incision (pharyngeal) in 135, external incision in 2 and transtonsillar incision in 2. In 5 an incision had been made before the patient entered the Children's Hospital. In 18 instances some form of general anesthetic was administered, 14 patients receiving ether and 4 gas and oxygen. In the other 144 cases no anesthetic was administered. Four patients were operated on in the upright posture. The remainder, as far as could be determined from direct mention of the position, were operated on in the prone or the exaggerated prone, so-called Rose's position.

In 115 cases the outcome was recorded as uneventful. In 4 instances tracheotomy was necessary, in 8 there was prolonged sepsis, in 14 supplementary or secondary incision into the abscess cavity was deemed advisable, in 8 secondary incision of infected cervical glands was necessary, in 12 incision was followed by a fever in which for some reason or other the temperature failed to return to normal, in 3 there was severe hemorrhage, and in 17 there were so-called late complications, such as meningismus, pneumonitis, otitis media, sinusitis, scarlet fever or unexplained cough.

Sudden severe, profuse hemorrhage, often recurrent, has been one of the most dreaded complications of retropharyngeal abscess. There were 3 instances in which such hemorrhage occurred, and in 2 it proved fatal. Sudden severe hemorrhage must be controlled at once by carotid ligation.

GENGHACH, Denver [AM J DIS CHILD]

## Nose

USE OF BENZIDRINE VAPOR IN CHILDREN J A SCARANO and J F COPPOLINO,  
Arch Pediat 54 97 (Feb) 1937

Benzedrine vapor was used in the treatment of rhinologic infections in 100 children. Prompt and adequate shrinkage of the nasal mucosa occurred, with no secondary reactions, local or systemic.

ORR, Buffalo [AM J DIS CHILD]

EXPERIMENTAL VACCINATION AGAINST COLDS IN AN INFANTS' HOME M J  
WALLFIELD, J Pediat 10 69 (Jan) 1937

Children in the Infants' Home, Brooklyn, who had had frequent colds and involvement of the upper air passages were chosen for the experiment. The ages ranged from birth to 6 years. In 1933 a commercial catarrhal vaccine (called vaccine B in the paper) was used. The following year, in addition to the commercial vaccine, a nonspecific vaccine (called vaccine A in the paper), obtained from saprophytic bacteria of the air, was used. The injections were begun in October of each year. One course of eight subcutaneous injections was given at the rate of two injections a week. The initial dose was 0.1 cc, and subsequent doses were increased gradually to 1 cc, a total of 4.6 cc being given to each child. In each experiment the period of observation was one year. All temperatures over 100 F were recorded, as well as the type and the number of infections of the upper part of the respiratory tract. Twenty-four children were given injections in 1933 and 40 in 1934. The results of the first year showed a reduction of 52 per cent in the number of days of fever and of almost 29 per cent in the number of colds in the vaccinated group. The results of the second year showed no appreciable difference in the number of days of fever and the number of colds between the group given the nonspecific vaccine A and the group given vaccine B. The nontreated controls showed an increase of 29 per cent in the days of fever and had almost 21 per cent more colds. Wallfield believes that better results might be obtained by increasing the dose of the vaccine or by using the particular antigen to which the children are sensitive.

RAUH, Cincinnati [AM J DIS CHILD]

EXTERNAL PUNCTURE AND DRAINAGE IN SUPPURATIONS OF FRONTAL SINUS K  
BECK, Arch f Ohren-, Nasen- u Kehlkopf 142 205, 1936

Beck describes further observations after the so-called puncture treatment of frontal sinusitis, which he recommended several years ago. Treatment involves drilling a small opening in the anterior wall and introducing a small cannula (1.8 mm thick), which is left in place for several days. Two or three times each day the secretion is aspirated and solution of epinephrine introduced into the cavity. Whereas the aspiration of the secretion is at first painful and only a little epinephrine can be introduced into the cavity, the pain and the swelling of the nasofrontal duct begin to subside. As soon as this duct is free, the cannula can be taken out and the small puncture opening heals. The author discusses and refutes some of the criticisms of this method. Regarding the indications for it, he says that in cases in which real empyema exists it is inadequate, because in such cases a wide opening according to one of the well known surgical methods is required. He shows that his puncture method is indicated chiefly in cases of acute and subacute frontal sinusitis accompanied with severe pain and refractory to the usual methods of treatment. In some cases the author observed the com-

plete absence of exudate, but the nasofrontal duct was closed. Simple opening, with or without the use of epinephrine, often counteracts the symptoms. Swelling with closure of the frontal duct and with stasis of the mucosal vessels is the chief problem. Opening of the sinus by puncture often effects improvement. In conclusion the author emphasizes that his method produces excellent results, provided it is used in the right type of case.

EDITOR'S ABSTRACT

RHINITIS CASEOSA VALERIE BALLÁCS, *Monatschr f Ohrenh* **70** 1432 (Dec) 1936

Ballács points out that the term rhinitis caseosa is derived from the character of the secretion, which consists of fetid scales, some of which are yellowish white and shiny while others vary from grayish yellow to brownish and form smeary crumbs or membranes. Former reports about rhinitis caseosa permit the differentiation of three types: (1) the uncomplicated type, in which a chronic impairment of the mucous membrane resulted in hypertrophy, polyposis, obstruction of the nose, increased secretion and stasis in the accessory sinuses, (2) the type in which exist deep-going inflammatory processes of the nasal mucous membrane, periostitis and osseous necrosis, and (3) the type that is complicated by rhinolithiasis, atrophy and ulcerations due to pressure. The author discusses 5 cases, 3 of which belong to the first type and 1 each to the second and the third type. He shows that the development of rhinitis caseosa is dependent on (1) the dystrophic condition of the mucous membrane, which is produced by chronic inflammation, (2) the secretory stasis resulting from the obstruction of the nose, and (3) the influence of as yet unknown micro-organisms the metabolic products of which transform the secretion into the caseous type characteristic for this type of rhinitis.

EDITOR'S ABSTRACT

### Miscellaneous

ARGYRIA A. W. STILLIANS, *Arch Dermat & Syph* **35** 67 (Jan) 1937

Stillians reviews the literature on argyria. The discoloration may be local or generalized and may be due to the absorption of silver during contact with it in industry or during therapeutic use of silver preparations, the most common instance being the continued unsupervised use of silver compounds by the laity in self treatment of nasopharyngeal ailments. Diagnosis is not difficult in that "in no other condition is there a bluish discoloration of the parts exposed to light while the rest of the skin remains ashy gray or even nearly normal in color." The only ideal treatment is prophylaxis. Only 1 case of cure of generalized argyria has been recorded besides the one reported by the author. He gave sodium thiosulfate orally and intravenously in large doses for one month, then methenamine intravenously for one month, without definite results. However, a plaque painted to match the skin was made at the onset of the treatment, and by comparison the "result was wholly satisfactory." The skin, because of the action of light, is probably the last to release its silver deposits. Local treatment consists in the intradermal injection of 1 per cent potassium ferrocyanide and 6 per cent sodium thiosulfate. In the case reported, each injection left a light spot almost as pale as normal skin. By many injections of the reducing solution the whole anterior portion of the face except the lower eyelids was cleared. If argyria develops in a child and the absorption of silver is discontinued at once, the prognosis is fair, for as the child grows, the silver deposit spreads over a large surface, and in this way the color is lightened.

DULIN, Iowa City [AM J DIS CHILD]

GENICULATE NEURALGIA (NEURALGIA OF NERVOUS FACIALIS) FURTHER CONTRIBUTION TO SENSORY SYSTEM OF FACIAL NERVE AND ITS NEURALGIC CONDITIONS J. RAMSAY HUNT, *Arch Neurol & Psychiat* **37**.253 (Feb) 1937

Although this article is primarily concerned with neuralgia arising from the geniculate ganglion, nevertheless the discussion of the anatomic features of the sensory and sympathetic nerves of the face and their relation to deep orbital pain

should be of interest to all ophthalmologists. There is a discussion of sphenopalatine ganglion neurosis (Sluder's syndrome), the pain of which is localized in the root of the nose, in and about the eye and in the upper part of the face and the upper teeth and sometimes also in the lower jaw, the lower teeth, in the temple and about the zygoma, the ear, the mastoid, the occiput and the neck, the hand and even the finger tips.

Hunt summarizes the neuralgic disorders of the various cranial nerves as follows:

1 True trigeminal neuralgia, which is distributed in one or more branches of the trifacial nerve and in which the pain is localized in the more superficial structures of the face and the intraoral region. This is classic prosopalgia or trifacial neuralgia. In cases of neuralgia of the third division of the fifth nerve there is often associated otalgia.

2 Genuiculate neuralgia, which involves the deeper structures of the face. This is characterized by pain in the deep posterior orbital, the palatal and the nasal region, with painful sensation of pressure in the face. This is genuiculate deep prosopalgia, and with it there is associated genuiculate otalgia.

3 Glossopharyngeal neuralgia, which is characterized by neuralgic pains in the distribution of the glossopharyngeal nerve at the base of the tongue and the adjacent regions of the throat and by associated otalgia.

4 Superior laryngeal neuralgia, of vagal origin, in which the pains are localized in the region of the larynx, with associated otalgia.

All these various forms are accessible to surgical intervention by the cranial method of approach through the posterior fossa, which exposes the fifth, the seventh, the ninth and the tenth cranial nerve. If this procedure is carried out with the use of local anesthesia, it is possible by touching any one of the nerves to reproduce the neuralgic pain, thus confirming the clinical diagnosis, which is often involved and difficult.

An excellent series of references is included.

R. IRVINE, Los Angeles [ARCH. OPHTH.]

#### OCULAR SIGNS OF THROMBOSIS OF INTRACRANIAL VENOUS SINUSES. FRANK B. WALSH, *Arch. Ophthalmol.* 17:46 (Jan) 1937.

The ocular signs of thrombosis of the cavernous and lateral sinuses are well known, but there is no complete agreement regarding the mechanism producing them. The ocular changes of thrombosis of the superior longitudinal sinus are even less well understood. Some of the conditions hitherto diagnosed as serous meningitis, pseudotumor of the brain or chronic arachnoiditis may be due to thrombosis of the venous sinuses in the presence of an abnormal pattern of the sinuses. Walsh correlates some of these possibilities with the anatomicopathologic changes in cases of septic thrombophlebitis of the cavernous and lateral sinuses.

Aseptic thrombosis occurs in the nonpaired sinuses, is rarely associated with purulent infection, shows a tendency to organization or resorption, is rarely complicated by meningitis and in one-half the cases is followed by extravasation into the brain and a tendency to softening. Septic thrombosis occurs in the paired sinuses and is characterized by frequency of purulent infection, meningitis and cerebral abscess, a tendency to purulent degeneration of the thrombus and, rarely, extravasations into the cerebrum and the cerebellum.

The thrombi grow in the direction of the flow of the blood stream, but they may develop in the opposite direction. Such retrograde development is frequent in the intracranial venous sinuses, where it may be accounted for by the absence of valves in many of the venous channels, as well as by the plentiful collateral circulation. Septic thrombi result in bacteremia and septicemia and, through direct extension, may give rise to abscess of the brain and meningitis.

In septic thrombophlebitis of the cavernous and lateral sinuses, chemosis appears to parallel exophthalmos, which may be unilateral or bilateral. The degree is variable and is much less marked when the cavernous sinus is involved through retrograde extension from the lateral sinus than when it originates from an anterior infection.

Edema of the lids is a striking feature in cases of fulminating thrombosis, especially when the thrombosis arises from an anterior infection. Infection, rather than vascular obstruction accounts for swelling of the lids. Walsh agrees with Faulkner that swelling of the lower lid is not pathognomonic of thrombosis of the cavernous sinus and may be due to infection of the antrum or of the ethmoid sinus.

Paralysis of the extraocular muscles is an early symptom. Ptosis develops later. Behr expressed the belief that external ophthalmoplegia is purely mechanical and is due to a lesion of the nerves in the cavernous sinus, caused by pressure or inflammation.

Internal ophthalmoplegia is rarely encountered at the first examination and is described as a late symptom. Parsons stated that paralysis of the external rectus muscle is the first sign of involvement of the second eye. He stated that such a paralysis is to be explained either by basilar meningitis or by increased intracranial pressure.

Anesthesia of the cornea occurs early, though increased corneal sensitivity has been observed. Cloudiness and necrosis of the cornea result from exposure. These are of slight importance in establishing the diagnosis. The fundus may remain normal throughout the course of the disease. Generalized retinal edema may be apparent. Pulsation of the retinal arteries was observed in 1 case but hemorrhages were infrequent.

Thrombosis of the longitudinal sinus usually commences in the middle fifth of the sinus. Anatomically, the high position of the sinus, the low pressure, the slow current and the presence of pacchionian bodies predispose to thrombosis. It occurs usually in debilitated infants and as a result of changes in the blood itself, notably chlorosis. Jacksonian convulsions occur frequently. Symptoms of involvement of the pyramidal tract confined to the lower limbs may be present. Conjugate deviations of the eyes occur often. Exophthalmos has been reported, but rarely. Papilledema and engorgement of the vessels of the scalp, the retina and the conjunctiva occur, but, on the other hand, there may be complete absence of these signs.

When the thrombotic process is septic and has extended to the longitudinal sinus from the lateral sinus, the prognosis for life is bad. Doyle in describing this type, concluded: 1. In the absence of meningitis, early apathy or stupor in a patient with evidence of thrombosis of the transverse sinus indicates infectious thrombosis of the superior longitudinal sinus by retrograde extension, especially if associated with choked disks or convulsions. 2. When tumor or inflammatory disease can be excluded, jacksonian seizures showing progression from one foot to the other or beginning in the foot and gradually involving the homolateral upper extremity suggest impairment of the circulation of the cerebral veins and probably thrombosis of the superior longitudinal sinus. 3. Abrupt onset of symptoms of increased intracranial pressure with fluctuations suggests thrombosis of the superior longitudinal sinus, as well as ventricular tumor. Absence of progression after a fair length of time or actual regression of symptoms is suggestive of thrombosis of the superior longitudinal sinus.

Bilateral papilledema is the outstanding symptom of thrombosis of the lateral sinus. Unilateral papilledema may be present at times.

SPAETH, Philadelphia [ARCH NEUROL & PSYCHIAT]

ALLERGY OF EYE, EAR, NOSE and THROAT L. UNGER, Illinois M. J. 71 47  
(Jan) 1937

Unger points out that one who has allergic symptoms in any part of his body is apt to have evidence of hypersensitivity in another organ. There is usually an increase in the percentage of eosinophils in the blood and in the secretions of the



eyes, the nose and the bronchial tubes Hay fever from pollen is probably the most frequent cause of allergy in the eyes Vernal conjunctivitis has not been definitely proved to be allergic The results of treatment from the allergic point of view have not been satisfactory So-called nonseasonal allergic conjunctivitis is due to sensitization to some substance other than pollen In treatment, the specific cause should be removed whenever possible When complete removal of the cause is impossible, desensitization should be attempted Patients with contact dermatitis of the eye are not allergic in the ordinary sense of the term They do, however, usually react positively to the patch test Recent work indicates that allergy is an important, perhaps the sole, cause of Meniere's syndrome Because of the serious nature of the condition, all patients with Meniere's disease should be subjected to a complete examination, including tests for allergy A large percentage of patients seen in rhinologic practice are definitely allergic Routine examinations of nasal secretions will change old methods of treatment Patients with mucous polyps are definitely allergic The best treatment to date for hay fever from pollen remains the injection of the appropriate extract of the pollen The value of nasal ionization is still in dispute, its results in the treatment of hay fever from pollen usually are not good, in the treatment of vasomotor rhinitis some workers report considerable success

BARBOUR, Peoria [AM J DIS CHILD]

ENCEPHALOGRAPHY WITH ETHYLENE HENRY NEWMAN, J A M A 108 461  
(Feb 6) 1937

Newman finds that the unpleasantness of encephalography is lessened and its scope of usefulness increased when ethylene, which is only one-fifth as soluble as nitrogen monoxide, although seven times as soluble as air, is used To date he has performed encephalography with the use of ethylene in 30 cases In 24 of these visualization of the ventricles and the subarachnoid channels was excellent, in 5, only fair, and in 1, poor In the last case, however, a subsequent trial with air yielded no better results A survey of 189 cases in which encephalography was performed with air showed no higher percentage of satisfactory results Because of the fairly prompt disappearance of ethylene in the subarachnoid spaces, it is essential that roentgen examination be made immediately after the injection, as a delay of as little as fifteen minutes may result in poor visualization The headache complained of during injection of the gas did not differ in kind or degree from that experienced by patients in whom air was injected After the injection, however, the condition of the patient presented a striking contrast to that following the use of air Most of the patients were comfortable within three or four hours and able to eat the evening meal, and in almost every instance they were up and about on the following day The average period of hospitalization following the procedure was reduced from three days when air was used to one and eighty-five hundredths days with ethylene, and the condition of the patients on dismissal was in general better than that after the longer period with air That the shorter period of recovery from headache is due to more rapid absorption of ethylene seems probable The author believes that the solubility of the gas, and not its anesthetic properties, is responsible for its advantage over air

EDITOR'S ABSTRACT [ARCH NEUROL & PSYCHIAT]

OBSERVATIONS ON EFFECT OF PRONTOSIL AND A RELATED COMPOUND IN HEMOLYTIC STREPTOCOCCUS INFECTIONS P GROSS, F B COOPER and R R MELLON,  
J Bact 33 72 (Jan) 1937

The observation has been made by other investigators that the protective and curative effect in mice of a new derivative of sulfanilamide known as prontosil soluble (the disodium salt of 4-sulfamidophenyl-2'-azo-7'-acetyl-amino-1'-hydroxy-naphthalene-3', 6'-disulfonic acid) discloses a remarkable paradox Mice infected with highly virulent mouse passage strains of human origin showed a much higher

percentage of recovery than mice infected with nonpassage human strains of low virulence. Realizing the effect of diverse strains in mice, the authors thought repetition with other strains desirable.

Accordingly, the Pion strain (Pasteur Institute) of relatively low virulence and the Stoddard strain, human type, of high virulence were employed. Although definitely favorable effects were noted with the Stoddard strain, no comparison can as yet be drawn between it and the Pion, owing to an unexpected fluctuation in virulence in the Stoddard strain. But with the Pion strain only 1 of 10 controls was alive after fifteen days, while 6 of the treated mice were alive and apparently normal. Similar results were obtained with the already known sulfanilamide.

In several clinical cases a favorable effect appeared, but in only 1—a case of meningitis due to a hemolytic streptococcus—was it of high evidential value. No final conclusions can be drawn.

STOESSER, Minneapolis [AM J DIS CHILD]

PAROXYSMAL TRIGEMINAL PAIN WITH TUMOURS OF NERVUS ACUSTICUS H L PARKER, J Neurol & Psychopath 17 256 (Jan) 1937

Trigeminal pain is rare in association with tumors of the acoustic nerve. Of 53 cases, Parker found only 4 in which there was disturbance of the sensation of pain. He reports 2 more cases. Because of the rarity of the two conditions, their simultaneous appearance could not be regarded merely as coincidental. The pain was identical in all respects to that of tic douloureux and, as in the latter, could be relieved by injection of alcohol into the peripheral branches of the fifth nerve. Similar occurrence of trigeminal pain in cases of disseminated sclerosis has been reported in the literature. The explanation of such a condition is not yet clear. It has been suggested by Harris that the syndrome of both trigeminal and glossopharyngeal neuralgia is due to septic inflammation of the terminal filaments of the nerves caused by dental, tonsillar or sinus infections, and that the condition may be inherited. Parker does not accept this view and is inclined to agree with Foerster that the condition is one of functional hyperexcitability in the nerve apparatus, conditioned and facilitated by many and different causes. Parker draws analogies between this condition and that of facial spasm and believes that the underlying mechanism is the same in both conditions.

N MALAMUD, Ann Arbor, Mich [ARCH NEUROL & PSYCHIAT]

NOSE AND THROAT IN RELATION TO RHEUMATIC DISEASES H BARWELL, Lancet 1 67 (Jan 9) 1937

When a sore throat has been followed by rheumatic fever it is proper, according to Barwell, that the tonsils should be removed. Numerous small nodules of lymphoid tissue remain scattered over the pharynx, so that acute pharyngitis can and does occur after tonsillectomy. Hence this operation does not with certainty prevent recurrence of acute rheumatism, though it makes it less probable.

Diagnosis of tonsillar sepsis is easy in many cases but difficult in others, as usual, it is more difficult to exclude the diagnosis of an unhealthy condition than to confirm it. Redness of the anterior pillar is considered an important sign. Squeezing the tonsil after cocaineization or aspirating it with a suction cup may give valuable evidence.

LANGMANN, New York [AM J DIS CHILD]

MIXED MENINGOCOCCAL AND STREPTOCOCCAL MENINGITIS A A CUNNINGHAM, Lancet 1:198 (Jan 23) 1937

An 11 month old boy was first admitted to a hospital with follicular tonsillitis and otitis media on the left. About a month later he was readmitted with meningococcal meningitis as well as a recurrence of the otitis media and mastoiditis. At operation the dura mater was incised. This incision may have been the path of secondary infection, but it is likely that the streptococci reached the meninges by direct extension from the ear.

If there is a mixed meningeal infection, the usual antimeningococcal therapy must be combined with immediate operation on the infected mastoid, but unless there is clinical evidence of an intracranial abscess, the membranes of the brain should not be opened

LANGMANN, New York [AM J DIS CHILD]

VESTIBULAR REACTIONS IN CHRONIC ALCOHOLISM J A BARRE and O METZGER, *Rev d'oto-neuro-ophth* 15 87 (Feb) 1937

During the past several years Barre and Metzger have studied the vestibular reactions in cases of chronic alcoholism and have accumulated the protocols in 60 cases. The cases are classified as instances of marked, moderate or slight polyn neuritis, instances of delirium tremens and instances in which there were no characteristic signs of polyn neuritis. Study of the results of vestibular examination show (1) The reaction to the rotation test is the first to be affected and is most profoundly modified in cases of chronic alcoholism, (2) in a certain number of cases of generally severe involvement caloric hyporeflexia is observed, and (3) the reaction to the galvanic test is almost always unaffected, even in severe conditions of long standing. The type of dissociation deserves emphasis and appears to be peculiar to chronic alcoholic intoxication. Possibly it is a manifestation of neuritis of the most peripheral vestibular nerve fibers, which would be in accord with what is known of the action of alcohol on the nerves.

DENNIS, San Diego, Calif [ARCH NEUROL & PSYCHIAT]

RELATION BETWEEN ENLARGED TONSILS AND MENTAL DEFICIENCY T BRANDER, *Monatschr f Kinderh* 69 57 (Feb) 1937

In 373 premature children aged from 7 to 15 years Brander found that the incidence of mental retardation was parallel to the degree of tonsillar hyperplasia. The greater the hyperplasia, the lower was the general average of the intelligence quotient. The defects of intelligence being of relatively mild degree, the tonsillar hyperplasia cannot be considered a factor of oligophrenia.

Brander does not claim that the associated mild mental defects are necessarily due to the enlargement of the tonsils. In the presence of large tonsils the symptoms of the more defective children seem to be accentuated. Perhaps enlargement of the tonsils and mental retardation have a common cause. Removal of tonsils may help some children, but it is valueless in such conditions as oligophrenia.

GERSTLEY, Chicago [AM J DIS CHILD]

IS LYMPHATIC TISSUE IN NASOPHARYNX A PROTECTION AGAINST INFECTION? G EIGLER, *Munchen med Wchnschr* 84 284 (Feb 19) 1937

The old theory that the lymphatic tissue in the nose and throat is a barrier to systemic infection is no longer tenable. Phagocytic cells, which are essential in the protection against invading organisms, are absent or sparsely present in the tonsils and the adenoids. Eigler fails to find histologic or biologic evidence that the tonsils and the adenoids aid in the development of antibodies. After these tissues have been removed surgically, a patient is less susceptible to catarrhal pharyngitis, diphtheria and scarlet fever.

BRAHDY, Mount Vernon, N Y [AM J DIS CHILD]

# Society Transactions

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## CHICAGO LARYNGOLOGICAL AND OTOLOGICAL SOCIETY

WALTER H. THROBOLD, M.D., *President*

*Regular Monthly Meeting, April 4, 1938*

### PAPILLOMA OF THE TONSIL REPORT OF THREE CASES Presented by DR. IRA FRANK

True tumors of the tonsils are rare lesions, those of the benign type being much less frequently observed than those of the malignant. Benign tumors include most commonly fibroma, papilloma, lymphoma and angioma, myoma, adenoma, lipoma, chondroma, teratoma and mixed tumor also occur but with far less frequency. Pedunculated or sessile papillomas or diffuse papillomatous hypertrophy of the tonsil, including epithelial elements, must be distinguished from the ordinary adenoid lymphoid hypertrophy of the tonsil, although from the clinical standpoint the distinction is almost exclusively of academic interest, either condition calling for tonsillectomy. (An extensive review of the literature was given.)

According to the records of the department of pathology of Michael Reese Hospital, in the past six years only 3 patients with hard papilloma of the tonsil came for examination. (Because of the rarity of reports of such lesions in the literature, short resumes of these 3 cases were given.) All the patients were men. The histologic changes were in general similar in all—a squamous papilloma, the squamous epithelium extending in finger-like, sometimes branching projections about a delicate core of connective tissue. The epithelial cells did not vary in structure, and the base of the projecting mass was well demarcated by the tonsillar epithelium. There were no signs of inflammation.

Clinically, papilloma of the tonsil is more frequently observed in adults than in children, it is probable, however, that in young subjects papillary hypertrophy may often be disguised under the general appearance of ordinary lymphoid tonsillar hypertrophy. Whether or not benign papilloma may become malignant is open to doubt.

Subjective symptoms are usually insignificant, there may be some irritation and soreness of the throat. If the growth is pedunculated it may form an impediment to respiration and swallowing. In some cases diagnosis has been made only after tonsillectomy for ordinary hypertrophy. In each of the 3 cases reported the clinical diagnosis of hard papilloma was verified by histologic examination.

The treatment is electrocoagulation or, better, complete removal of the affected tonsil.

### DISCUSSION

DR. HOWARD BALLENGER: I am under the impression that papilloma of the tonsil is somewhat more common than one would assume from Dr. Frank's review of the literature. It is possible that some of these small isolated polyp-like growths that one sometimes sees on the tonsil are not true papillomas. I have seen a few of that type which I have called papilloma but have not always checked by a microscopic section. It is probable that most of the cases are not reported in the literature.

DR. FRANCIS LEDERER: Two questions arise in connection with this presentation: first, whether in Michael Reese Hospital all tonsils were routinely sectioned to find these 3 cases recorded by Dr. Frank and, second, whether they were serially

sectioned in order to be certain that such a report could be interpreted with any degree of accuracy. In this instance there is again lack of evidence that reference to the literature supplies a fundamental basis for argument. As Dr. Ballenger said, I am certain that many more such instances are observed by clinicians than are recorded in the literature. I believe that if one canvassed the physicians who have observed these benign tumors, particularly those of papillary type, it would be found that such lesions are more common than this report would indicate.

DR. IRA FRANK. I cannot answer Dr. Lederer absolutely. Since there were gross lesions, I believe that only tonsils showing something abnormal were sectioned. I, too, thought the condition occurred much more frequently than it does until I looked up the literature.

#### A CASE OF STREPTOCOCCIC MENINGITIS WITH STREPTOCOCCEMIA. RECOVERY. Presented by DR. ALFRED LEWY

R. L. H., aged 14, was operated on May 5, 1937, for acute mastoiditis and subperiosteal abscess. She was discharged from the hospital on June 4, 1937, with a dry ear and the wound healed.

She was readmitted on July 29, 1937, with a history of headache of two weeks' duration, vertigo and vomiting and blurring of vision. She was in a coma two days before admission.

Examination showed a slight discharge from the right ear, tenderness in the mastoid scar, stupor and rigidity of the neck, the Kernig, the Brudzinski and the Babinski signs were positive, facial twitching was manifested, there was paresis of all the right extraocular muscles and of the left external rectus muscle. Examination of the blood showed 70 per cent hemoglobin, 4,000,000+ erythrocytes and 21,000 leukocytes, the urine contained albumin, a few granular casts and a few red and white cells. The spinal fluid under pressure showed 710 cells per cubic millimeter, the hemolytic streptococcus was found in smear and culture. Four successive cultures of the spinal fluid were positive, the fifth being sterile. Three successive cultures of the blood were positive for hemolytic streptococci, and the fourth was negative.

A radical mastoidectomy was performed. The dura was uncovered in the middle and posterior fossae, exposing the lateral sinus. The cisterna pontis lateralis was drained with iodoform gauze. Sulfanilamide was administered, the initial dose was 60 grains (3.88 Gm.) with sodium bicarbonate, and 60 grains (3.88 Gm.) was given daily by mouth with 5 cc. ampules of prontosil (the disodium salt of 4-sulfamido-phenyl-2'-azo-7'-acetyl-amino-1'-hydroxynaphthalene-3', 6'-disulfonic acid) intramuscularly daily for four days. This treatment was then discontinued for three days, and solution of potassium arsenite, 2 minims (0.12 cc.) three times a day, was substituted, then administration of sulfanilamide was resumed. Transfusions of small doses of whole blood were given on the second, the fourth and the seventh day. The temperature was normal on the thirteenth day. At this time the optic disks were still blurred, were elevated 1.5 diopter and showed some flame-shaped hemorrhages. These eventually disappeared. Thereafter recovery was uninterrupted.

Five months later the patient is still somewhat anemic but has resumed all normal activities. The left knee jerk is absent, otherwise neurologic findings are normal. She is still under observation.

#### DISCUSSION

DR. GEORGE S. LIVINGSTON. I recall a previous report by Dr. Lewy of a cure in a case of otitic meningitis in which drainage of the lateral pontile cistern was used but sulfanilamide was not. Two such isolated reports might make one wonder whether the surgical procedure was not more important than the drug, but general experience, of course, points in the opposite direction. Dr. Lewy has

asked me to discuss sulfanilamide therapy from the standpoint of dosage. In cases of meningitis, the adequacy of the dose is probably the determining factor for recovery. From experimental evidence it is known that to protect mice against streptococcic peritonitis a concentration of sulfanilamide in the blood stream of 10 to 15 mg per hundred cubic centimeters is required. If one uses these figures as a guide, one can then determine an approximately adequate dose, which should then be adjusted to the requirements in the individual case. It has been found that it takes forty-eight hours to attain the desired concentration of sulfanilamide in the blood. If one begins with the usually recommended dose of  $\frac{3}{4}$  grain (0.05 Gm) to each pound (0.5 Kg) of body weight in twenty-four hours, in two days one should make a quantitative determination of sulfanilamide. This is done by the colorimetric test devised by Marshall and his co-workers. In cases of meningitis the cerebrospinal fluid as well as the blood should be tested. If the amount is low and the clinical condition has not improved, the dose should be increased.

Sulfanilamide has been found to be excreted at the same rate that it is ingested, and under such circumstances it is sufficient to test the urine content of the blood. In seriously sick patients, however, with meningitis or septicemia, there is a considerable derangement of renal function, so that the test of the urine is unreliable.

I believe that only by frequent quantitative determinations on the blood can potentially fatal infection be safely and intelligently treated with sulfanilamide. Not all infections can be cured with sulfanilamide, but the percentage of recoveries will be increased by the use of these means of adjusting the dosage to the peculiar requirement of the individual patient.

DR THOMAS GALLOWAY. Since the first of last year at the county hospital 9 patients proved to have streptococcic meningitis have recovered by the use of sulfanilamide and its derivatives, 1 without operation, which is something that was impossible previously, so the effectiveness of the drug cannot be denied. As Dr Lewy showed, however, proper surgical treatment of the infective focus is still essential. As to the colorimetric test for the proportion of the drug in the blood, it is not difficult and is routine at the Evanston Hospital. An attempt is made to get only a level of 5 mg per hundred cubic centimeters.

The routine doses at Cook County Hospital are  $\frac{3}{4}$  grain (0.05 Gm) per pound (0.5 Kg) of body weight for about three days, then  $\frac{1}{2}$  grain (0.03 Gm) on succeeding days. Recently sulfanilamide has been used in a concentration of 0.8 per cent in salt solution given intravenously. It is interesting to know the amount of the drug being used, twelve thousand 5 grain (0.32 Gm) tablets were used at Cook County Hospital last month in the treatment of streptococcic infections, and Dr Fantus is proposing that its administration be limited to cases of serious conditions because of the cost and because of the possibility of unfavorable results from its use.

DR FRANCIS LEDERER. There are two points that occurred to me in connection with Dr Lewy's case report. He ceased giving sulfanilamide at the time the patient became cyanotic. I hoped that Dr Livingston would talk on that point. According to the modern concept of treatment with sulfanilamide, the therapy must be continued despite the cyanosis, which will then subside. There is another point I wish to bring up, viz, has that child entirely recovered? Somehow or other, judging from the history which Dr Lewy presented, one would suspect that the child may have a latent abscess of the brain. With inability to make a proper recovery, indicated by pallor and failure to gain weight, there should be a strong suspicion of this possibility.

DR M REESE GUTTMAN. One of the drawbacks in the use of large amounts of sulfanilamide has been the danger of methemoglobinemia. Recently an antidote for this condition encountered in the use of sulfanilamide has been found in methylthionine chloride. Small doses are hypodermically injected three times a day. This has been found effective in preventing the occurrence of sulfhemoglobinemia. When the condition has appeared clinically it has disappeared in about twenty-four hours after the use of methylthionine chloride.

DR ALFRED LEWY The important thing is to bring out the management by sulfanilamide. Operations have been performed for streptococcal meningitis for many years without any notable success until administration of sulfanilamide was begun, and in addition to the 2 cases of Dr Galloway in which recovery occurred without operation, I have a case and have knowledge of another in which operation was refused and the child recovered. I think the drug must be given credit for recovery in most cases. That is why it is so important to understand the drug, how to use it, when to discontinue it and what the dose should be in the individual case.

The question of abscess of the brain in this case has been uppermost in my mind, and for that reason the child is still under observation. The child lives out of town, and since the family is poor I strongly suspect that the rather slow recovery may be due to lack of proper food. I have tried to make arrangements with the county nurse to see that she gets the sort of food she should have. I shall continue to watch her for evidence of residual complications in the brain.

#### PSYCHIATRIC THERAPY FOR DYSPHEMIA AND DYSPHONIA Presented by DR JAMES SONNETT GREENE

In this issue, page 213, appears an article by Dr Greene, entitled "Psychiatric Therapy for Dysphonia. Aphonia, Psychophonasthenia, Falsetto," which includes the material presented in this report except the section on dysphemia, an abstract of which follows.

##### DYSPHEMIA (STUTTERING)

Stutterers are sympathicotonic neurotic persons whose disorganization, both psychic and somatic, is so marked and so common to all of them that they can be classed as "stutter-type neurotic." The neuropathic diathesis of the stutter-type neurotic person is a hereditary trait. Apparently a disorder is passed on from parents to children which predisposes them to nervous and emotional instability but which is only to a degree a specific organ weakness or inferiority. The chief factor seems to be a disturbance in some stabilizing mechanism—probably a hypothalamic involvement.

Further, the stutter-type person belongs to that group which Pavlov classified (in terms of nervous excitation and interruption of psychomotor function) as "strong but unbalanced." He demonstrates a combination of the harmful effects of excessive excitation and abnormal interruption in his motor functions, so that there is an interference with that inner rhythm so necessary for integrated functioning. When this fundamental lack of rhythm is combined with the high emotional tone of sympathicotonia, one can readily see why the stutterer is predisposed to disorganization and chronic hesitation in general.

Under stress, the behavior of the stutter-type person takes the form of irregular, hesitating physical manifestations, which may be apparent in any of his psychomotor activities. When speech is involved, one designates it as stuttering.

Even with his neuropathic diathesis, the stutter-type person is not necessarily destined to stuttering speech. Only an unfavorable environment—an environment of opposition—which accentuates the native conflicts of the individual, can evoke stuttering in its various forms.

In the stutter-type child, the conditioned reflex of speech is unstable because of his lower grade of psychomotor efficiency, and when such a child is reared in an oppositional environment he easily acquires stuttering speech as a physical manifestation of his underlying diathesis. In such a child any marked initial environmental impact is enough to cause a disturbance in speech. Through anxiety and fear, the experience is repeated again and again, until a definite neural pathway via the cerebral cortex is built up and stuttering speech occurs as a conditioned reflex.

As the child grows older and the social situations become more complex, a chain of humiliations, failures and frustrations is set up, resulting in an anxiety-fear neurosis which in time warps the whole personality. Stuttering, then, is

not a speech defect as the term is conventionally understood, but a deficiency specialization, and all therapeutic measures instituted for stuttering speech must take into consideration the function of the organism as a whole—the entire personality

## DISCUSSION

DR ELMER L. KENYON I first met Dr Greene almost exactly twenty-seven years ago, in Berlin. We came to America, and we have met but a few times since. We have taken different courses. I have taken a path which has attempted to help build up a national movement for handling speech problems. Dr Greene has stuck closely to his institute. The field covered in his paper tonight is so large that a complete discussion will not be attempted. I wish I might talk about the different types of cases mentioned. Others in the work have handled them all and have handled them effectively and often not in the way described by Dr Greene. With respect to stuttering, or stammering—it is a matter of fashion whether one uses the one term or the other—there are perhaps six or eight definite theories with respect to the etiology of this disorder, of which one is Dr Greene's. I have no doubt that none of these theories are true in their entirety. Thus treatment is still on an empiric basis and for the individual physician is determined largely by his own conception of etiology.

Dr Greene's marked emphasis on what he designated the "stutter type" of person, on which type of personality he believes stuttering depends, is certainly open to question. In 90 per cent of cases the condition begins before the sixth year of life. Why the disorder starts is not known or, at any rate, not agreed on. If the patient continues to stutter he is in a serious situation. He cannot make good in expressing himself. His peculiar efforts at speech constitute a subject for ridicule. He fears to talk. Whatever there may be of a "stutter type" in the stutterer seems to me to be chiefly a development caused by stuttering itself. This is borne out by the fact that no one can foretell which particular child or adult will begin stuttering and also by the fact that after recovery the former stutterer takes his place in life and usually appears no different from other persons.

Dr Greene's success in treatment, namely cures in 70 per cent of the cases, is excellent. I have never seen published statistics which have indicated above 25 per cent of successes. As to my own treatment of stuttering, I approach the problem from the psychophysiologic standpoint, and when I can obtain complete cooperation I have no failures. This attainment of success in treatment by such widely different methods further indicates how doubtful is Dr Greene's "stutter type" conception of etiology.

DR C. T. SIMON I should like to raise a question with Dr Greene and make a statement of my own. The question is: How many cases has he found in which the condition has started after the age of 6 years? As Dr Kenyon mentioned, practically all stuttering is reported to start before the age of 6 years, and it is possible to get the complete family history. Further, it seems many children exhibit symptoms of stuttering but never become stutterers, but sometimes something happens and the boy or girl changes into a stutterer. I wonder whether any information has been found in case histories concerning the greater frequency of stuttering among boys than girls. Why is it more often in boys than in girls that the early symptoms are fixed into a permanent stutter? There is no satisfactory answer to that.

I think that in dealing with stutterers one should get away from the idea that the stutterer is abnormal or deviates sharply from the characteristics of normal persons. From every observation that can be made, the stutterer differs from the normal person only in terms of his speech. Some are beginning to think that the emotional abnormality found in the adult stutterer in all probability is the result of the defect in speech, rather than the reverse.

DR JOSEPH C. BECK I should like to speak about this condition from a public standpoint, economic standpoint and charitable standpoint, because many of these



unfortunate persons are without a job and hopeless, and they go away after Dr Greene treats them, ready to take a position in society

I met Dr Greene in Toronto three years ago. He told me the details of his work—using more terms than any dermatologic professor ever employed. That night, at a meeting of the American Board of Examiners, I sat down next to Dr Mosher and he said to me, "What's the matter with you? You are stammering!"

What interested me in this lecture tonight was the reference to aphonia, hysterical aphonia. All practitioners used to treat patients with this condition and say they were cured. I recently had a disturbing case. The patient had a cyst of the vocal cord. I told Dr Guttman to take it off, and he did. He told the patient to be quiet awhile, and she has been quiet ever since. She has normal cords, and they move all right. I suppose the trauma, getting the instrument into the throat, produced the difficulty. She was hoarse from the neoplasm, but now that it is gone she is aphonic.

I should like to ask if Dr Greene has ever used hypnosis in any of his cases. Mention is made by Europeans of the use of hypnosis in treating these patients.

DR A. H. ANDREWS, JR. Dr Greene has used a term tonight which I think deserves more emphasis, namely, "organism as a whole." This is important from a philosophic standpoint. The results of his work in curing this type of patient are evident. The same holds true in many other fields. The medical profession has been held back for many years by the Aristotelian concept of dividing a subject into parts, studying their various components and trying to add them up again and get the whole. One should try rather to get a concept of the whole. This holds true for organic as well as for functional diseases and for other parts of the body as well as for the larynx.

DR AUSTIN A. HAYDEN. I should like to ask what Dr Greene does for the correction or the adjustment of speech for deaf persons.

DR J. S. GREENE. In reference to imitation as one of the causes of stuttering, it can definitely be said that the percentage of those who commence to stutter as a result of imitation is large, especially when there is an older stutterer in the immediate family.

In reference to Dr Beck's question as to whether surgical measures should be instituted in cases in which the voice is affected before vocal treatment is undertaken, this of course depends entirely on the nature of the condition. In the case of the tumor of the vocal cord just mentioned surgical procedure is indicated and should be followed by vocal treatment. In answer to his question about the value of hypnotism, I wish to say that hypnotic therapy was given up a long time ago. In this country at the present time it is used only occasionally and simply as an experimental measure. One of the principal reasons for its disuse is that stutterers are introverts and it has been found that it is much more difficult to hypnotize introverted, self-centered persons than so-called extroverts.

In regard to the ratio of men to women among stutterers, an uneven sex distribution has been found. About eight times as many boys as girls stutter. There are obvious reasons for this. First and foremost is the fact that early environmental stress is never so hard on girls as on boys. The element of social competition enters into the life of even the youngest boys much more decisively than into that of girls. Boys are injected into an incomparably more strenuous atmosphere of group games, in which the prowess of much older boys sets the standard. In other words, the social impact is stronger for boys, and it necessarily follows that stuttering is more common among them.

Another factor in the uneven sex distribution of stutterers is that girls inherently possess a finer nervous mechanism, a higher rhythmic sense, better coordination and a higher progressive trend, and for that reason they are less likely to lose their standard of organization under new environmental conditions.

Some persons seem to have been born more awkward than others. The stutterer is one of these persons. He shows his lack of coordination not only in

speech but in his general activities. For instance, a mother will often say that her stuttering child is more clumsy than the other children in everything he does.

Given such a child with a neuropathic diathesis, living in a neurotic environment, it is easy to see how almost any strong environmental impact will precipitate a general disorganization. Since speech is the finest psychomotor function, it is only natural that a certain percentage of these children should show this general disorganization through disturbance of speech. These are temperamental, stutter-type persons who have a relatively high potential for the spread of emotional tone.

To integrate these disorganized persons is the basic problem of treatment. Speech is secondary, because stutterers can all talk when they are alone or with children or animals. I am sure Dr. Kenyon will bear me out.

The first thing new patients are told at the medical-social clinic is that their speech is a matter of no interest. This seems incomprehensible to a person who for twenty or thirty years has centered all his thoughts on that very thing. It is growth and rehabilitation of personality that is of interest, although corrective work in speech must be done to counteract individual negative habits of speech. Muscular relaxation and coordination are important phases of the therapy. The aim is to inculcate a sense of rhythm and harmony and to diminish tension. Even fencing is used to promote standardization, gracefulness and accuracy of movement.

Of course, the ultimate aim of all phases of the therapy is to promote emotional control and to change the stutterer's warped personality. It has been found that stutterers respond under the right type of guidance, and the therapeutic measures carried out at the medical-social clinic have demonstrated that they have tremendous developmental potentialities.

I see these persons grow. They come in fearful and timid, many of them unable to hold positions. There are doctors, lawyers, accountants and engineers among the patients, all with good educations but unable to meet the outside world. They are given standardization and organization. Their entire emotional pattern is changed, so that they are able to meet life objectively and on an adult level. That is the answer to the stutterer's problem.

In reply to Dr. Hayden's question about therapeutics for the deaf, such work is not carried on on an extensive scale. The patients are usually referred to the League for the Hard of Hearing.

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## DIAGNOSIS AND DIFFERENTIAL DIAGNOSIS OF DEAFNESS

SAMUEL J. CROWE, M.D.

BALTIMORE

It is impossible to discuss within the allotted time all phases of the subject assigned to me, and the following facts about the diagnosis of middle and inner ear deafness are presented because I know they are accurate and think they will be of value in the interpretation of hearing tests.

There are three common types of impairment of hearing, the type due to a lesion of the conduction apparatus which interferes with the transmission of sound to the cochlea; that due to a lesion in Corti's organ or the cochlear nerve which interferes with the perception of sound, and a combined conduction and perception deafness. It is possible to have impaired hearing due to a nuclear or auditory pathway lesion but this is rare and when it occurs the patient always has symptoms of intracranial tumor or of a degenerative process in the central nervous system. Probably more than 98 per cent of all deafness is due to a lesion in the middle or inner ear or in the cochlear nerve. Observations made in the Otological Research Laboratory of Johns Hopkins University<sup>1</sup> in 1928 on patients with an infiltrating glioma show that after the cochlear nerves enter the brain stem their bilateral representation is so complete that the entire right temporal lobe or indeed the entire right cerebral hemisphere may be removed without impairing the hearing in either ear. To cause deafness a tumor of the brain or other type of central lesion must be extensive enough to involve the auditory pathway on both sides. This of course is not true when the cochlear nerve within the temporal bone or in the cerebellopontile angle is affected.

Before discussing the diagnosis of the different types of impaired hearing I wish to call attention to changes in hearing brought about by

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From the Otological Research Laboratory of the Johns Hopkins University.

Read at the Forty-Fourth Annual Meeting of the American Laryngological, Rhinological and Otological Society, Atlantic City, N. J., April 28, 1938.

1. Bunch, C. C.: Auditory Acuity After Removal of the Entire Right Cerebral Hemisphere. *J. A. M. A.* 90:2102 (June 30) 1928.

age.<sup>2</sup> The chart in figure 1 is an average of the audiograms of 693 patients with normal hearing for their age. With each decade the hearing for the high frequencies becomes more and more impaired. It is essential to know this when interpreting an audiometer chart.

Many abnormal conditions in the middle ear cause no impairment of hearing, such as a tympanic membrane retracted and adherent to the promontory and fibrous or myxomatous tissue in the niche of the round window, as illustrated in figure 2. Every otologist has seen dry perforations, scars or deposits of calcium in the tympanic membrane that do not impair hearing.

The three conditions in the middle ear that do impair hearing are partial or total obstruction of the eustachian tube, any lesion that interferes with the movement of the ossicles, and fixation of the footplate of the stapes due to otosclerosis.

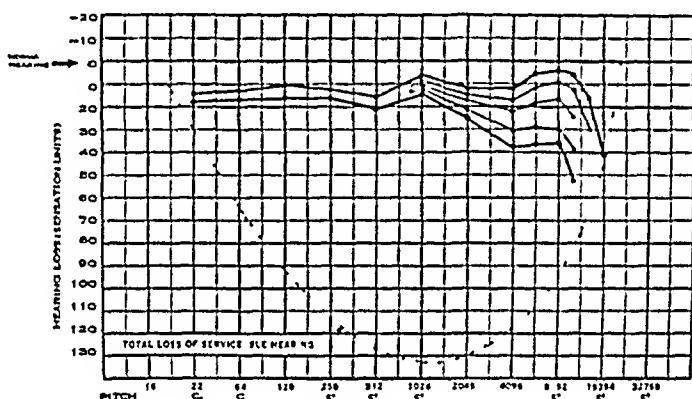


Fig 1—An average of the audiograms of 693 patients with normal hearing for their age (Bunch and Raiford's chart 10 transferred to a standard audiograph form). With advancing age there is little change in the ability to hear 1024 double vibrations and all lower tones, with each decade above the age of 20 there is increasing impairment for the higher frequencies.

For diagnostic purposes and for the prevention of a common type of deafness in early adult life it is important to know that during the early stages of obstruction of the eustachian tube in children the hearing is more impaired for high than for low tones (fig 3).<sup>3</sup> The cause for obstruction of the eustachian tube in childhood is an overgrowth of lymphoid tissue around its pharyngeal orifice, a hypersecretion of mucus

2 Bunch, C. C., and Raiford, T. S. Race and Sex Variations in Auditory Acuity, *Arch Otolaryng* **13** 423-434 (March) 1931. Ciocco, A. A. Observations on the Hearing of 1,980 Individuals. A Biometric Study, *Laryngoscope* **42** 837-856 (Nov.) 1932.

3 Crowe, S. J., and Guild, S. R. Impaired Hearing for High Tones, *Acta oto-laryng* **26** 138-142, 1938.

in the tube or a chronic suppuration in one or more of the peritubal cells without clinical evidence of otitis media. A child suffering from one of these conditions is fortunate to have acute otitis media which

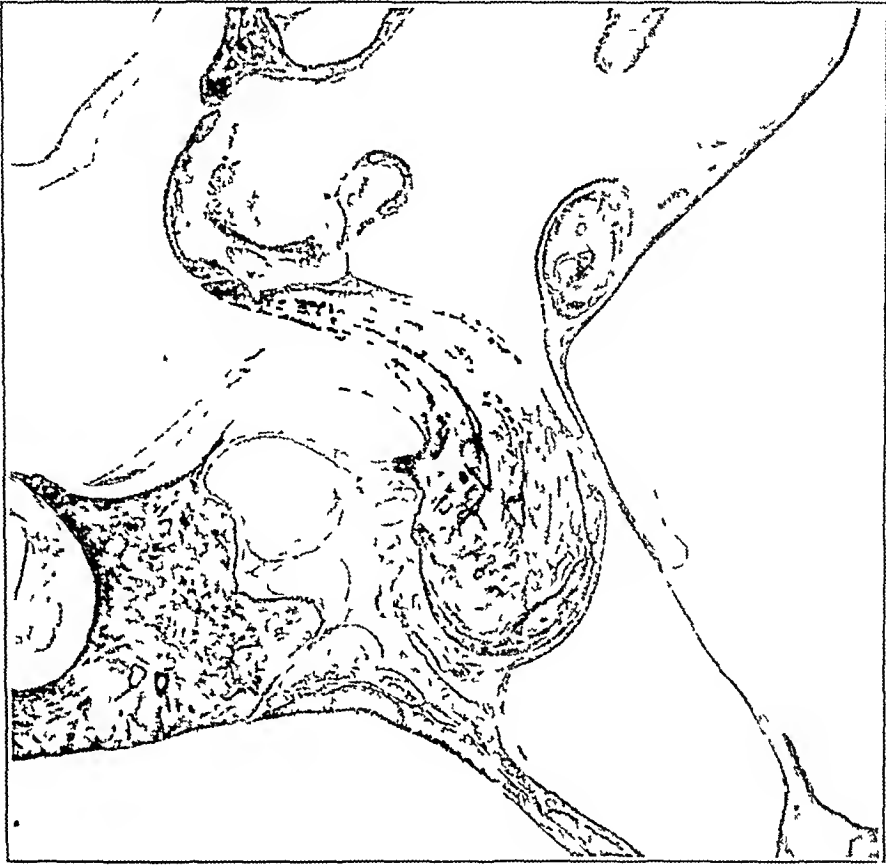


Fig 2—The tympanic membrane is adherent to the promontory and the round window niche is filled with myxomatous tissue. The ossicular chain and cochlea are normal. The hearing of this patient, aged 17, was normal.

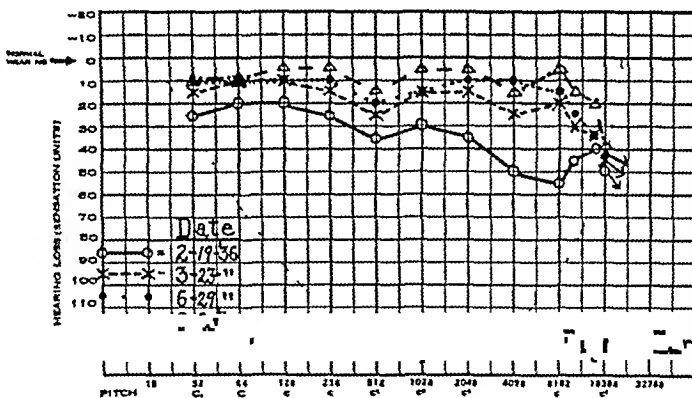


Fig 3—Impaired hearing, greater for high tones (solid line), and the improvement that followed radium treatment of lymphoid tissue in and around the pharyngeal orifice of the eustachian tube.

directs attention to his ears. Deafness, which may not appear until much later in life, should always be thought of when a child has fre-



vibrations becomes involved the patient begins to be noticeably deaf. At this stage which may not be reached for ten years or more the damage in the middle ear is often permanent and treatments by roentgen irradiation, inflation, tubal applications and dilations are of no avail.

The correlations between functional test and histologic study<sup>4</sup> given in figures 4, 5, 6 and 7 show that any lesion which interferes with movement of the ossicles causes a marked loss of hearing. In the

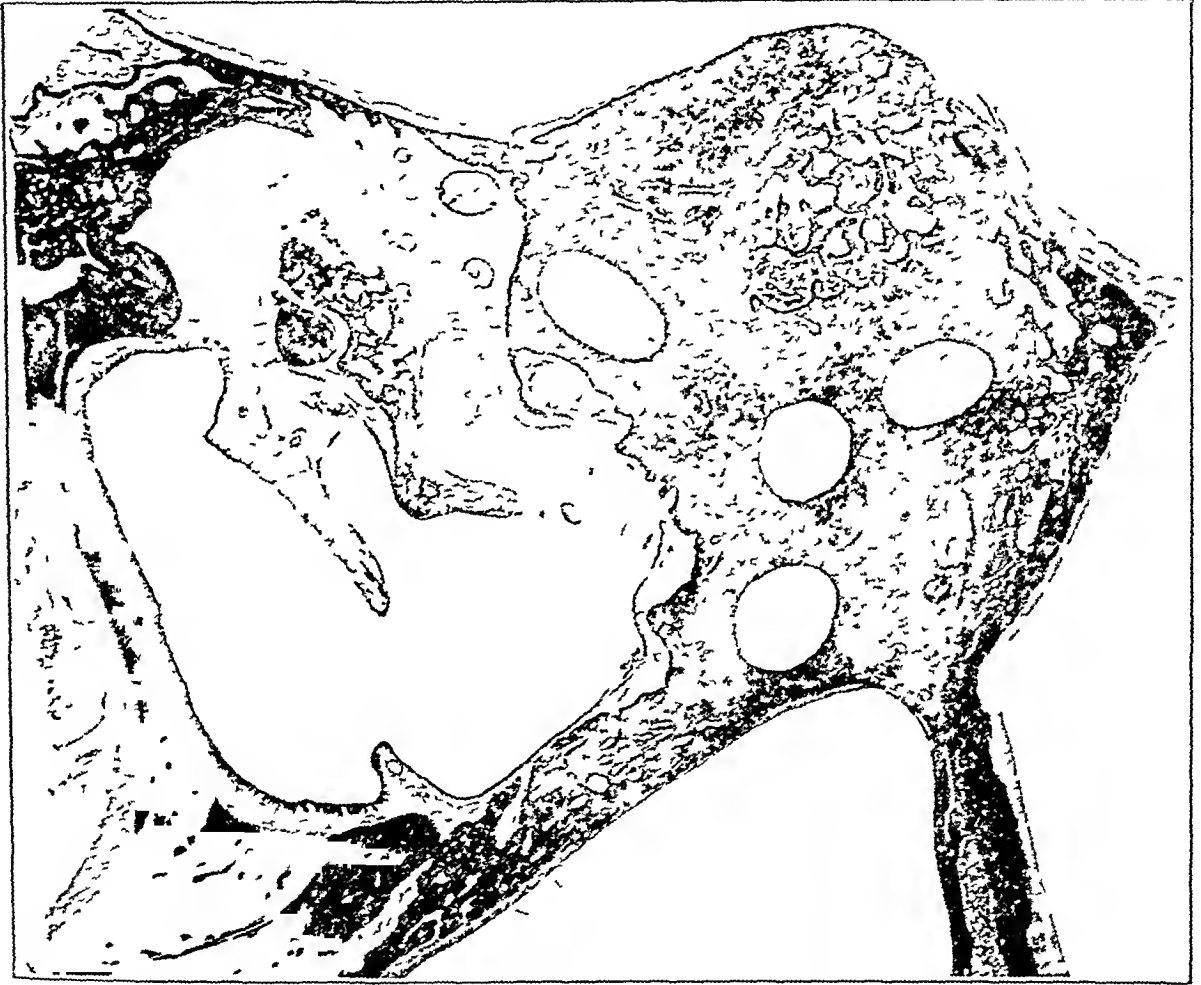


Fig 5—Conduction deafness due to chronic suppuration in the middle ear. There is a defect in the tympanic membrane and the head of the malleus and the incus are embedded in fibrous tissue. The stapes is relatively free and the cochlea normal.

presence of obstruction of the eustachian tube or of a lesion which interferes with the movement of the malleus and incus, the impairment of hearing usually begins with the higher frequencies, while in the presence of otosclerosis involving the stapes alone, the low as well as

<sup>4</sup> Polvogt, L. M. and Bordley, J. E. Pathologic Changes in the Middle Ear of Patients with Normal Hearing and of Patients with a Conduction Type of Deafness, *Ann Otol, Rhin & Laryng* 45:760-768 (Sept.) 1936.



the high tones are impaired. This is illustrated by the audiogram and photograph of the stapes in figure 8. In the case of ankylosis of the stapes illustrated here, histologic study of the cochlea shows no lesion of the nerve or its end organ, and the round window membrane is normal. The inference is that high frequencies are not transmitted to the cochlea through the round window membrane.

In addition to changes due to age and conditions in the middle ear, the early stages of involvement of the inner ear or of the cochlear nerve may cause a selective loss of hearing for high tones. I shall give

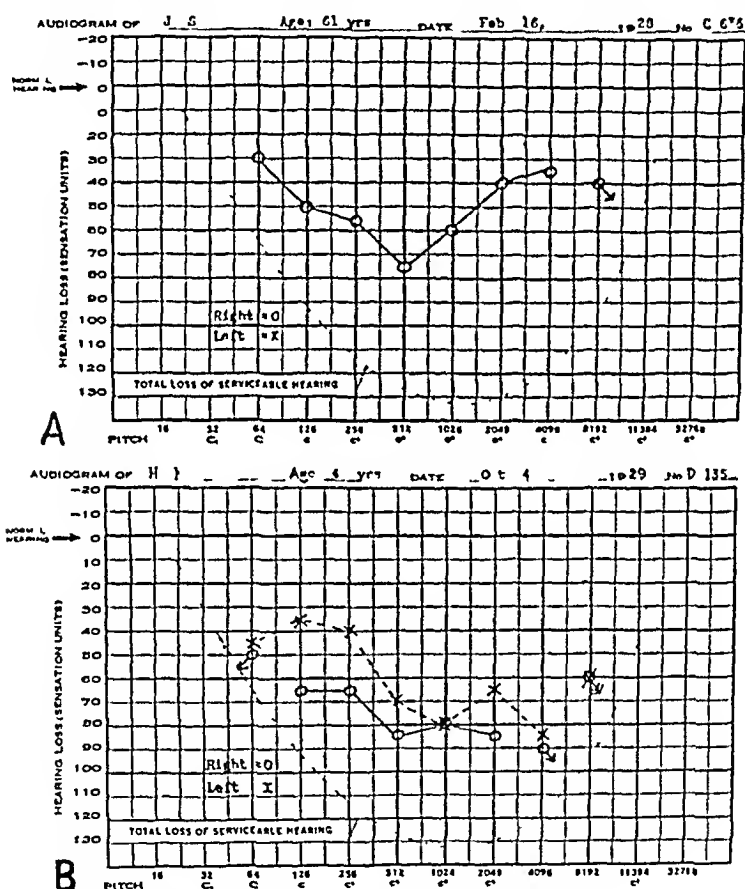


Fig 6—A, audiogram of the ear pictured in figure 5. Impairment in the middle of the speech range is greater than for the lower and higher tones. B, audiogram of the ear pictured in figure 7. The hearing is impaired more for high than for low tones, and no tone above 4096 is heard.

three examples. 1. An acoustic tumor (fig 9) which originates in the vestibular nerve but is not large enough to compress either blood vessels or nerves against the bony walls of the internal meatus causes no symptoms of any kind.<sup>5</sup> As it grows the patient begins to have occipital

5 Hardy, M., and Crowe, S. J. Early Asymptomatic Acoustic Tumor. Report of Six Cases, Arch Surg 32 292-301 (Feb) 1936.

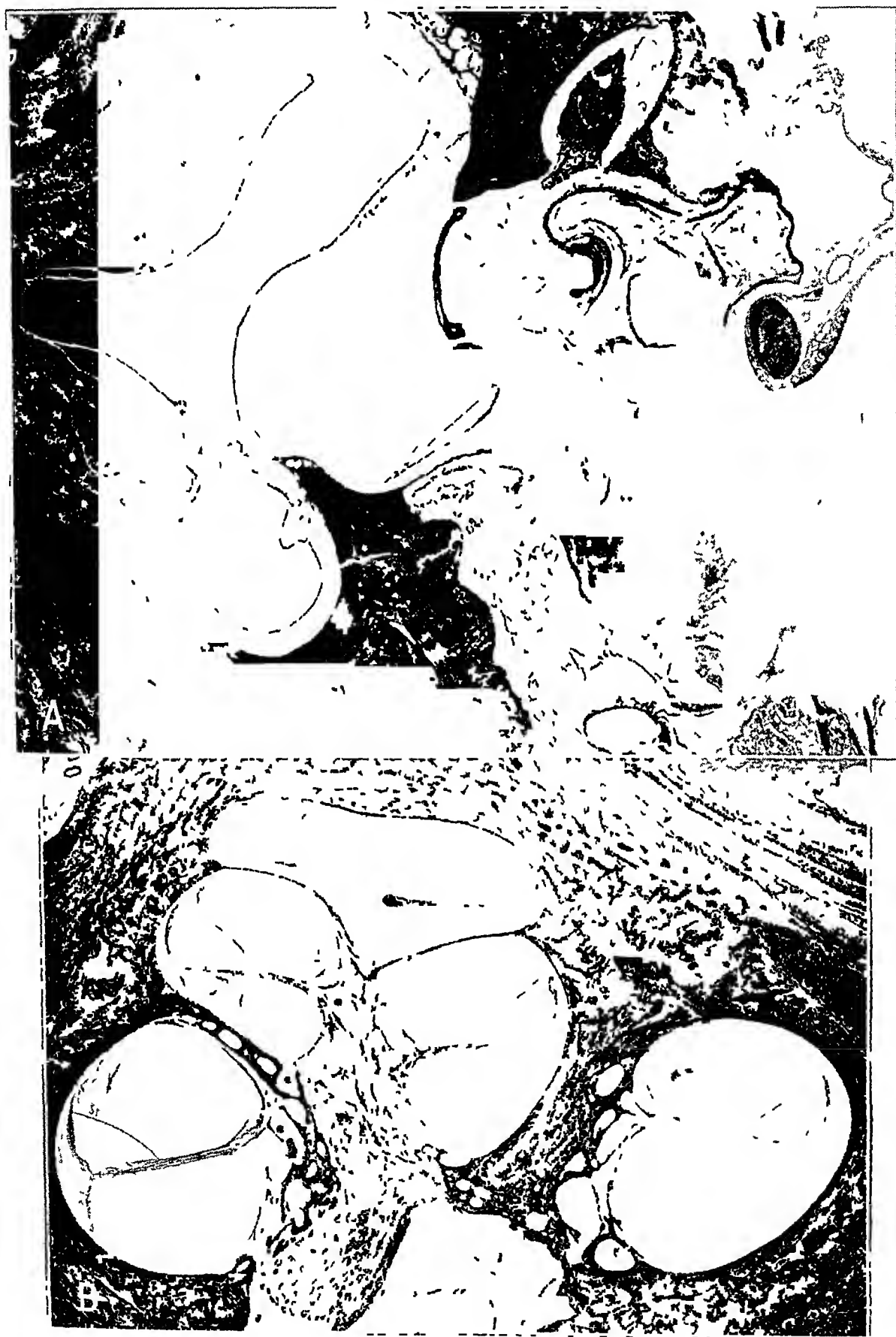


Fig 7—*A*, entire stapes embedded in scar tissue and round window niche filled *B*, normal nerve and Corti's organ in all turns of the cochlea This case illustrates how much impairment can result from pure middle ear lesions

headache, ataxia and, what concerns otologists, impaired hearing for high tones, as shown in figure 10. As the tumor increases in size, the deafness progresses by involving the lower tones until the audiogram becomes a straight line, and the final stage is total deafness. When involvement of the fifth nerve, choked disk and other signs and symptoms are diagnostic of an advanced acoustic tumor, the otologist

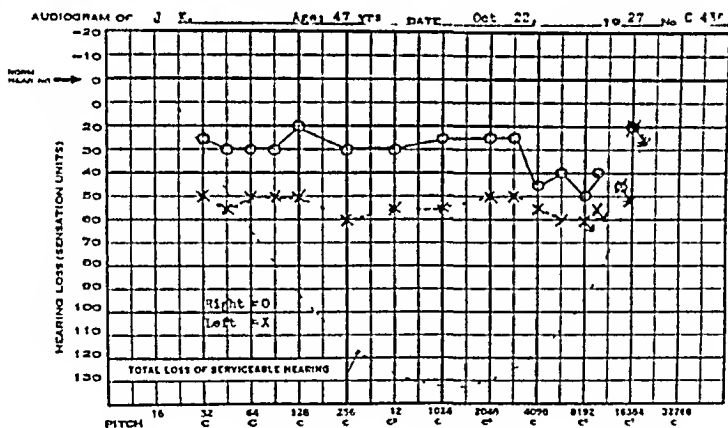
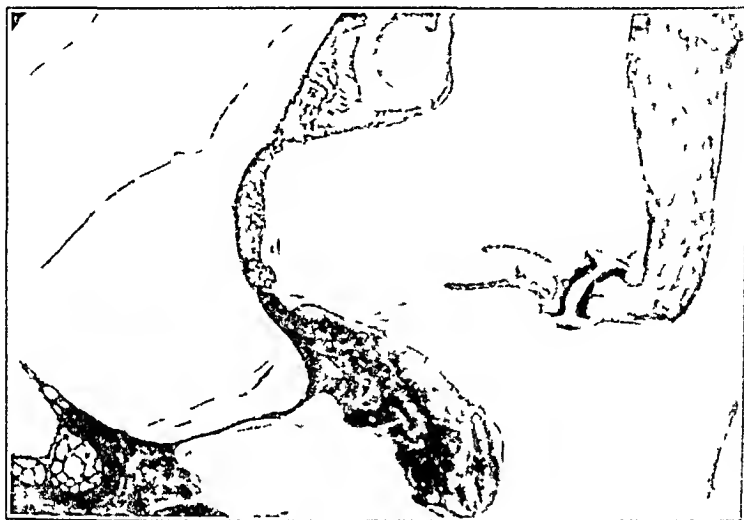


Fig 8—Ankylosis of the footplate of the stapes of the left ear, due to otosclerosis. Other parts of the middle ear and the ossicular chain are normal. Audiogram of the same ear, showing an equal impairment for high and for low tones.

may draw a false conclusion from audiometer and tuning fork tests if he fails to use masking, as illustrated in figure 11. The audiometer test of the patient concerned showed impaired hearing for 4096 double vibrations and the two highest tones on the right, and on the left a moderate impairment for all tones except those above 4096, which are not heard. When the test is repeated with the good ear masked, it

shows total deafness on the left 2 Ménière's disease<sup>6</sup> causes progressive deafness, as shown in figure 12 The patient whose audiograms are shown was having vertigo, tinnitus and some difficulty in hearing in the right ear in November 1934, as the disease progressed

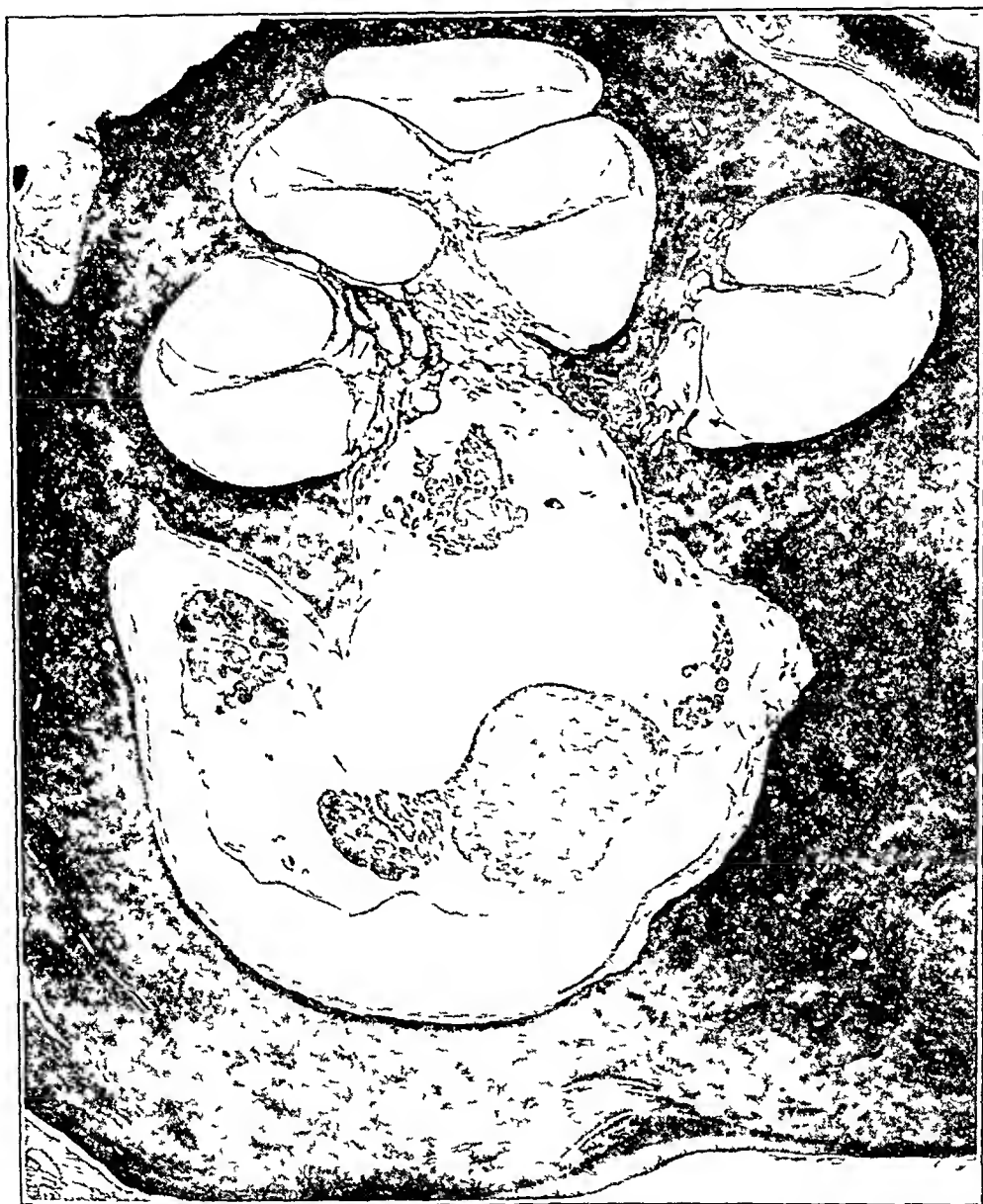


Fig 9—Asymptomatic acoustic tumor arising in the vestibular nerve, accidentally discovered As a tumor in this location increases in size it compresses the nerves and blood vessels against the bony walls of the internal meatus, and the first auditory symptom is impaired hearing for high tones

the hearing for low tones became more and more impaired, as shown by the tests made in January 1935 and April 1937 3 When patients

<sup>6</sup> Crowe, S J Ménière's Disease A Study Based on Examinations Made Before and After an Intracranial Division of the Vestibular Nerve, *Medicine* 17 1-36 (Feb) 1938

with Menière's disease are treated by intracranial division of the vestibular nerve, some of the cochlear nerve is occasionally divided, since the two nerves are so closely bound together. The invariable result of such an accident is a total loss of hearing for one or more octaves in the high end of the scale. This is clearly shown in figure 13. The entire vestibular nerve and all but a few fibers of the left cochlear

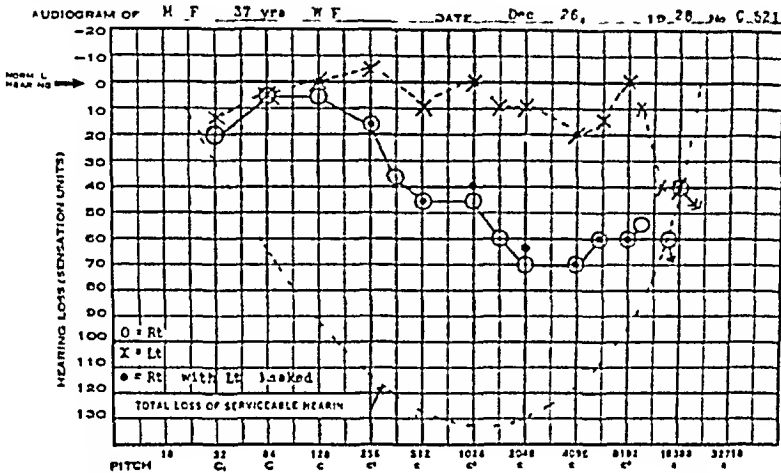


Fig 10 Hearing good for low tones but impaired for high tones owing to an acoustic tumor on the right, which was larger than the one shown in figure 9

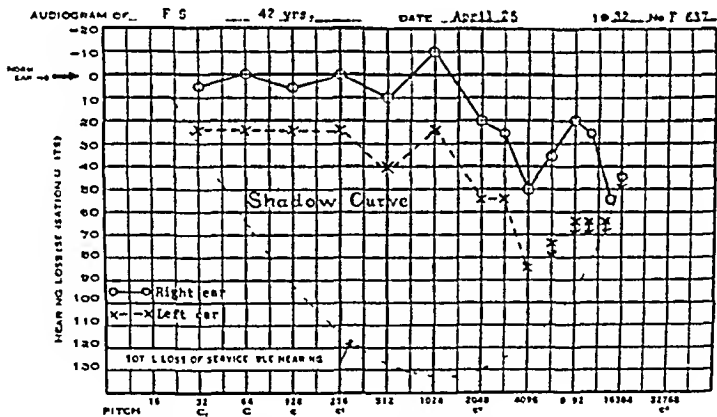


Fig 11—Audiogram of a patient with a large tumor of the cerebellopontile angle on the left. The audiogram of the left ear is false, when the right was masked, total deafness on the left was demonstrated

nerve were divided. Before operation the patient heard all tones up to 8192 double vibrations, when tested a year later she failed to hear anything above 256, but for 128 and lower tones there was little change. This observation suggests either that transmission of the higher frequencies to the brain requires a large number of nerve fibers or that

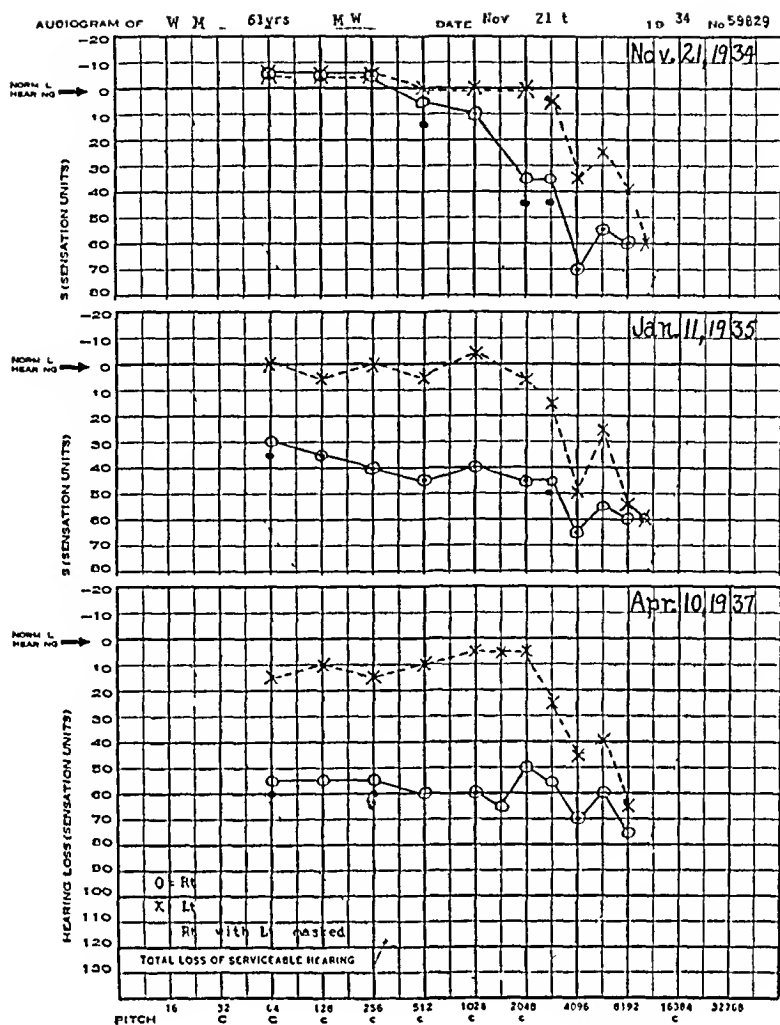


Fig 12—A series of audiograms of a patient with Ménière's disease. The first auditory symptom was tinnitus and impaired hearing for high tones, as the deafness progressed the hearing for low tones became more and more impaired.

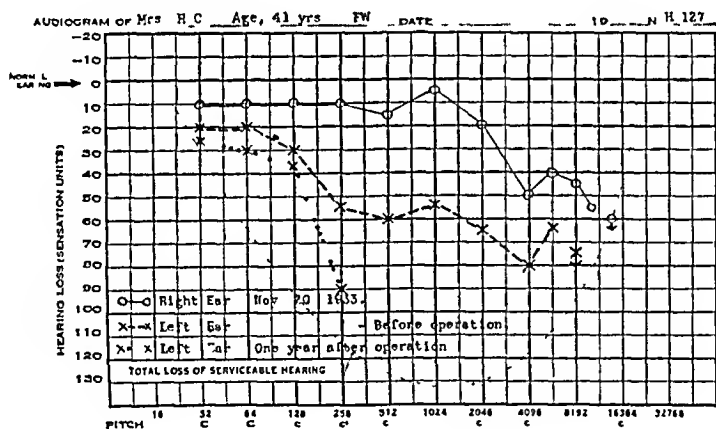


Fig 13—The first auditory symptom of an acoustic tumor is impaired hearing for high tones (fig 10). As more fibers of the cochlear nerve are pressed on by the growing tumor the hearing for lower tones is affected. A similar type of hearing impairment results when some of the cochlear nerve is accidentally divided at operation for Ménière's disease (fig 12). When a few cochlear fibers are cut only one or two octaves at the high end of the scale are lost, but when most of the nerve is cut four and a half octaves are lost. This audiogram shows the hearing for 256 double vibrations also to be much impaired.

there is localization in Corti's organ for high tones only and low tones are transmitted by any undamaged nerve fibers that remain, without regard to the location of their end organ in the cochlea

Other studies on inner ear deafness made in this laboratory<sup>7</sup> showed conclusively the localization in the cochlea for 2048 double vibrations

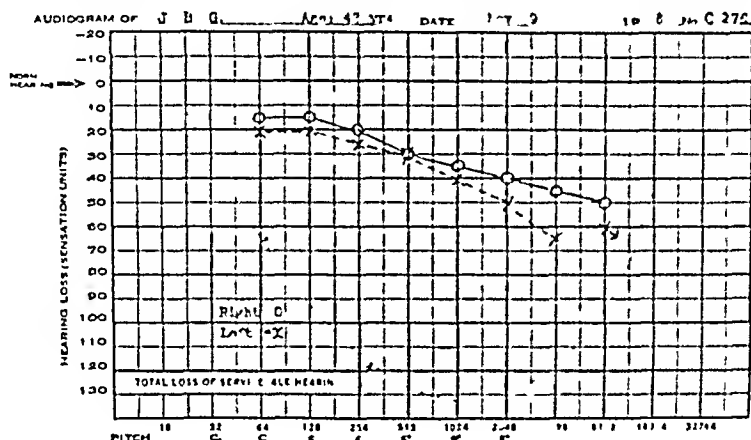


Fig 14—When there is no clinical evidence of conduction deafness and the audiogram shows good hearing for low tones but increasing impairment for each octave toward the high end of the scale, the lesion is an atrophy of the nerve supplying the basal turn of the cochlea. The cause is unknown.

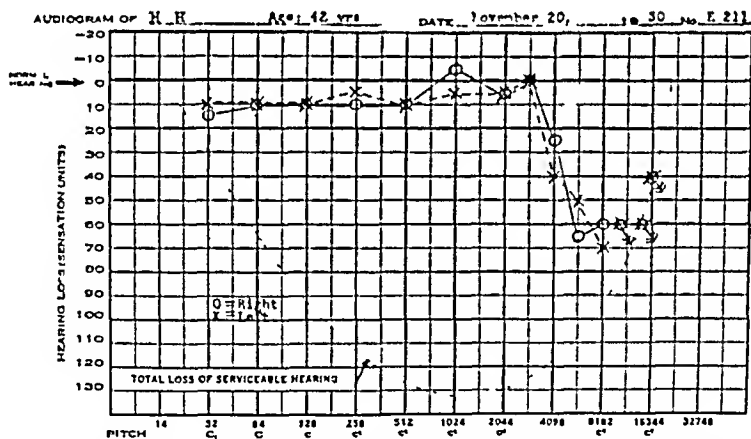


Fig 15—When the middle ear and the tube are normal and the hearing is good for all tones below 2000 or 3000 double vibrations, but is markedly impaired for all higher tones, the lesion is an atrophy of both nerve and Corti's organ in the basal coil. The cause is not known.

and higher frequencies, but no evidence was found for localization of tones below 2048. Two points of practical importance in the differ-

7 Crowe, S. J., Guild, S. R., and Polvogt, L. M. Observations on the Pathology of High-Tone Deafness, *Bull. Johns Hopkins Hosp.* 54:315-379 (May) 1934.

ential diagnosis of deafness resulted from this study.<sup>7</sup> When the eustachian tube and the middle ear are normal and the audiogram shows good hearing for low tones but an impairment which begins at 256 or 512 and increases gradually with each octave toward the high end of the scale, as illustrated in figure 14, the lesion is an atrophy of the cochlear nerve supplying the basal turn of the cochlea. The organ of Corti is not affected, and the nerve to the upper middle and apical coils is normal. When the eustachian tube and middle ear are normal and the audiogram shows an abrupt or sharply localized impairment for high tones, as in figure 15, both the nerve and the organ of Corti in the basal coil are atrophic. The cause is unknown, but the location and type of lesion are known. Intensive study of patients with these types of hearing defect is the only way to add to knowledge of their causes, no information on this subject has come from animal experiments.

Audiometers, tuning forks and masking were discussed in the report of the committee on hearing tests of the American Otological Society.<sup>8</sup>

In conclusion I wish to emphasize the fact that a differential diagnosis of the various types of deafness cannot be made with tuning fork or audiometer tests alone. To be of any value an audiometer test must always be supplemented with fork tests. The only way to make a satisfactory differential diagnosis is to take a detailed history, to examine the upper air passages, the tympanic membranes and the eustachian tubes and to use masking when making the hearing tests. In otology as in other branches of medicine a sound knowledge of anatomy and pathology is essential for an understanding of functional disorders.

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<sup>8</sup> Report of the Committee on Methods of Testing the Hearing by Bone Conduction, *Ann Otol, Rhin & Laryng* 45 800 (Sept) 1936



# STAPES, FISSULA ANTE FENESTRAM AND ASSOCIATED STRUCTURES IN MAN

I FROM THE EMBRYO OF SEVEN WEEKS TO THAT OF TWENTY-ONE WEEKS

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In the course of a comprehensive study of the anatomy of the human ear, it was early realized that more precise information was needed on the development and the adult form and structure of the stapes. Not until such information became available could pathologic structure of the stapes be certainly distinguished from normal or the extent of alteration be determined. Of almost equal importance is information concerning the neighboring area—the vestibular window, fissular tracts and islands of osseous tissue of types peculiar to the temporal bone. The present paper represents the initial phase of a study of the stapedia area and includes six developmental stages between the embryo of 22.8 and that of 183 mm crown-rump length, subsequent papers will carry the study through the stages of infant, child and adult (to the age of 70).

## MATERIALS AND METHODS

For this investigation reconstructions of the stapes, together with the surrounding area, were prepared by the wax plate method<sup>1</sup>. Representative developmental

From the Departments of Anatomy, Otolaryngology and Surgery, Northwestern University Medical School. Contribution 267 from the Anatomical Laboratory.

Read at the meeting of the American Association of Anatomists, April 20, St. Louis, 1935. The investigation was conducted under the auspices of the Central Bureau of Research of the American Otological Society, with the general superintendence of Dr. J. Gordon Wilson.

1. The reconstructions in figures 1, 2 and 3 were prepared at a magnification of 250 diameters and the others at 125 diameters. The reconstructions of the earlier stages (22.8, 29 and 40 mm) were prepared from the right ear and those of the advanced stages (135, 161 and 183 mm) from the left ear. The various reconstructions include sections as follows: 22.8 mm embryo (fig. 1), 33 sections, 29 mm (fig. 2), 30, 40 mm (fig. 3), 70, 135 mm (figs. 24 and 25), 78, 161 mm. (figs. 28 and 29), 82, 183 mm (figs. 20 and 31 to 33), 84, and 70 year (fig. 22), 86. Drawings for figures 1, 2 and 3 were prepared at the full dimensions of the reconstructions and reduced one seventh in reproduction. Drawings for figures 4,

*(Footnote continued on next page)*

stages were selected from the series of sections in the Harvard Embryological Collection, the collection in the department of anatomy at the University of Wisconsin and that in the department of otolaryngology at the Northwestern University Medical School

These series were lent by Profs F T Lewis, J Lewis Bremer, T H Bast and J Gordon Wilson

Reconstructions were made of the following stages

Embryo	Stage	Age	Source	Series	Figures
	228 mm	7½ weeks	Harvard	737	1, 4
	29 mm	8½ weeks	Harvard	914	2, 5
	40 mm	10 weeks	Harvard	1917	3, 6
	135 mm	17 weeks	Wisconsin	5	7, 8, 13, 14, 24, 25
	161 mm	19½ weeks	Wisconsin	13	9, 10, 15, 16, 28, 29
	183 mm	21 weeks	Wisconsin	21	11, 12, 17-19, 20-21, 31-33, 34-35
Adult		70 years	Northwestern	3-3-34	22, 23

The series loaned by Professor Bast are among those on which his excellent study of ossification was based (Bast, 1930<sup>2</sup>)

#### OBSERVATIONS AND DISCUSSION

*Embryo of 228 mm Crown-Rump Length (7½ Weeks)*—The stapes is histologically discernible as a fairly distinct mass of precartilaginous in the human embryo of 175 mm,<sup>3</sup> the exact line of demarcation

5 and 6 were prepared at one-fourth and for figures 7 to 12 at one-half the full size, thus bringing them to the same magnification in the plate, all were reduced three fifths in reproduction, in figures 9 and 12 the osseous tissue is indicated by stippling, and in the latter figure its limits are marked by arrows. Drawings for figures 14, 16, 18 and 19 were prepared at one-half the full size of the reconstructions and drawings for figures 13, 15 and 17 at one-fourth the size, all these were further reduced one third in reproduction. Drawings for figures 20 to 23 were prepared at one-half the size of the original reconstructions and reduced four sevenths in reproduction.

Photographs for figures 24 and 25 were taken at two-ninths the size of the original reconstruction and reproduced without reduction, those for figures 28 and 29 at two-ninths the size of the original and then reduced one sixth in reproduction, those for figures 31 to 33 at one-fifth the original size and reduced two ninths. The photomicrographs in figures 30, 34 and 35, were taken at a magnification of 31 diameters and are reproduced without reduction, those in figures 26 and 27 were reduced one fifth.

All dimensions presented in the table and the text are computed from measurements made on the reconstructions.

2 Bast, T H. Ossification of the Otic Capsule in Human Fetuses, Publication 121, Carnegie Institution of Washington, 1930, *Contrib Embryol* **21** 53 (June) 1930.

3 This is series 2155 in the Harvard Collection, in the numerous series of somewhat younger embryos the stapes is represented merely by a mesenchymal concentration. Likewise, in specimens from the Carnegie Collection the stapes is not clearly discernible in stages earlier than that of 18 mm (15 mm, no 350, 16 mm, no 317, and 17 mm, no 296), but it is distinguishable in the embryos of 18 mm (no 3609), 20 mm (no 128) and 21 mm (no 4148) as an area of condensed mesenchyme, not yet by the presence of cartilaginous matrix. At 23 mm (no 966) the matrix is clearly distinguishable. So far as can be judged from a study of sections, the stapes in the 25 mm embryo (no 4304) is similar in form to that in the 228 mm stage illustrated in our figures 1 and 4.

between the precartilage and the mesenchyme is, however, indefinite, the one merging by slow gradation into the other. At this stage, according to Streeter (1918),<sup>4</sup> the capsule, although still composed of precartilaginous tissue, is distinctly outlined.

In the embryo of 22.8 mm the distinction is sharpened, cartilage being distinguishable from precartilage. The "stapes" is not yet stirrup shaped, but is annular, it is without definitive head, crura or base (figs 1 and 4), these subdivisions of the future stapes are predictable only on the basis of relationship to the window and the incudal cartilage.

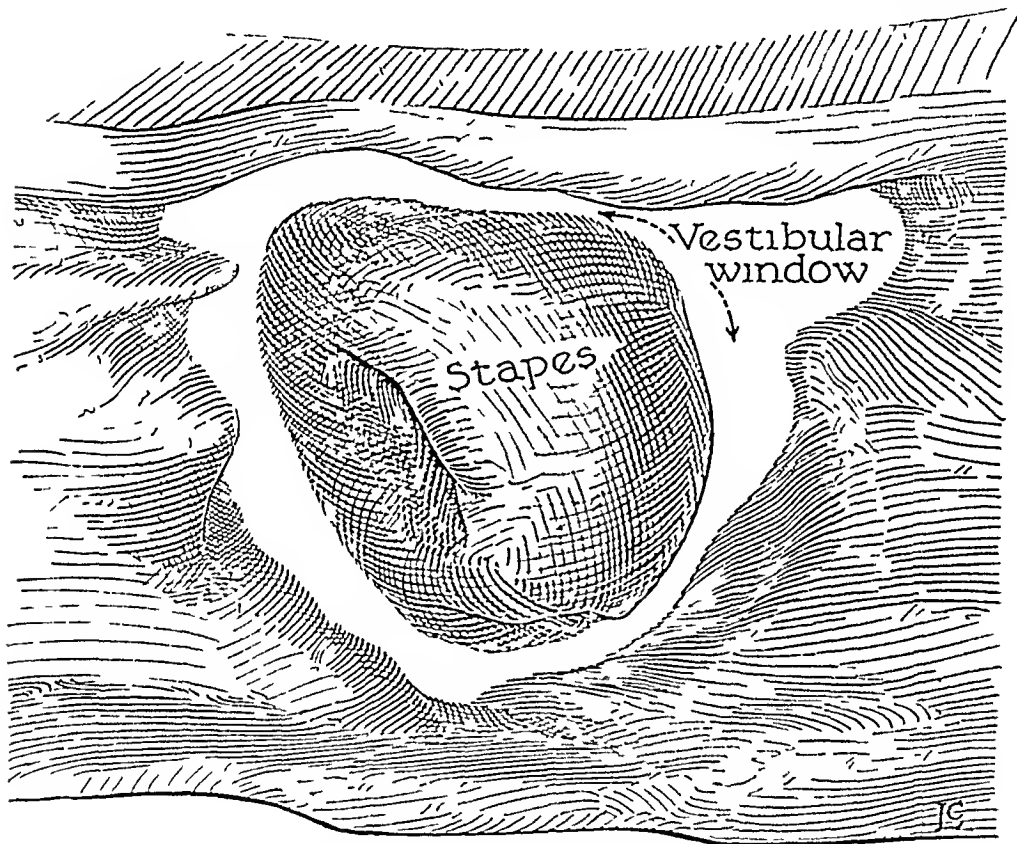


Fig 1—Reconstruction of the stapes and adjacent portion of the vestibular window in embryo of 22.8 mm,  $\times 214$  (compare fig 4)

The intercrural space is round and regular. The base of the stapes has not attained the reniform outline characteristic of the adult ossicle (fig 1).

The length of the stapes from the base to the head is 0.294 mm, the length of the base is 0.248 mm, the anterior crus is 0.292 mm long and the posterior crus 0.284 mm. The stapes is solid cartilage.

4 Streeter, G. L. The Histogenesis and Growth of the Otic Capsule and Its Contained Periotic Tissue-Spaces in the Human Embryo, Publication 227, Carnegie Institution of Washington, 1918, *Contrib Embryol* 20: 5-54, 1918.

The outline of the vestibular window is irregular, and the space between the stapedial base and the fenestral margin is relatively wide. The labyrinthine capsule is entirely cartilaginous.

*Embryo of 29 mm Crown-Rump Length (8½ Weeks)*—The form of the stapes at this stage has changed but slightly (figs 2 and 5), but

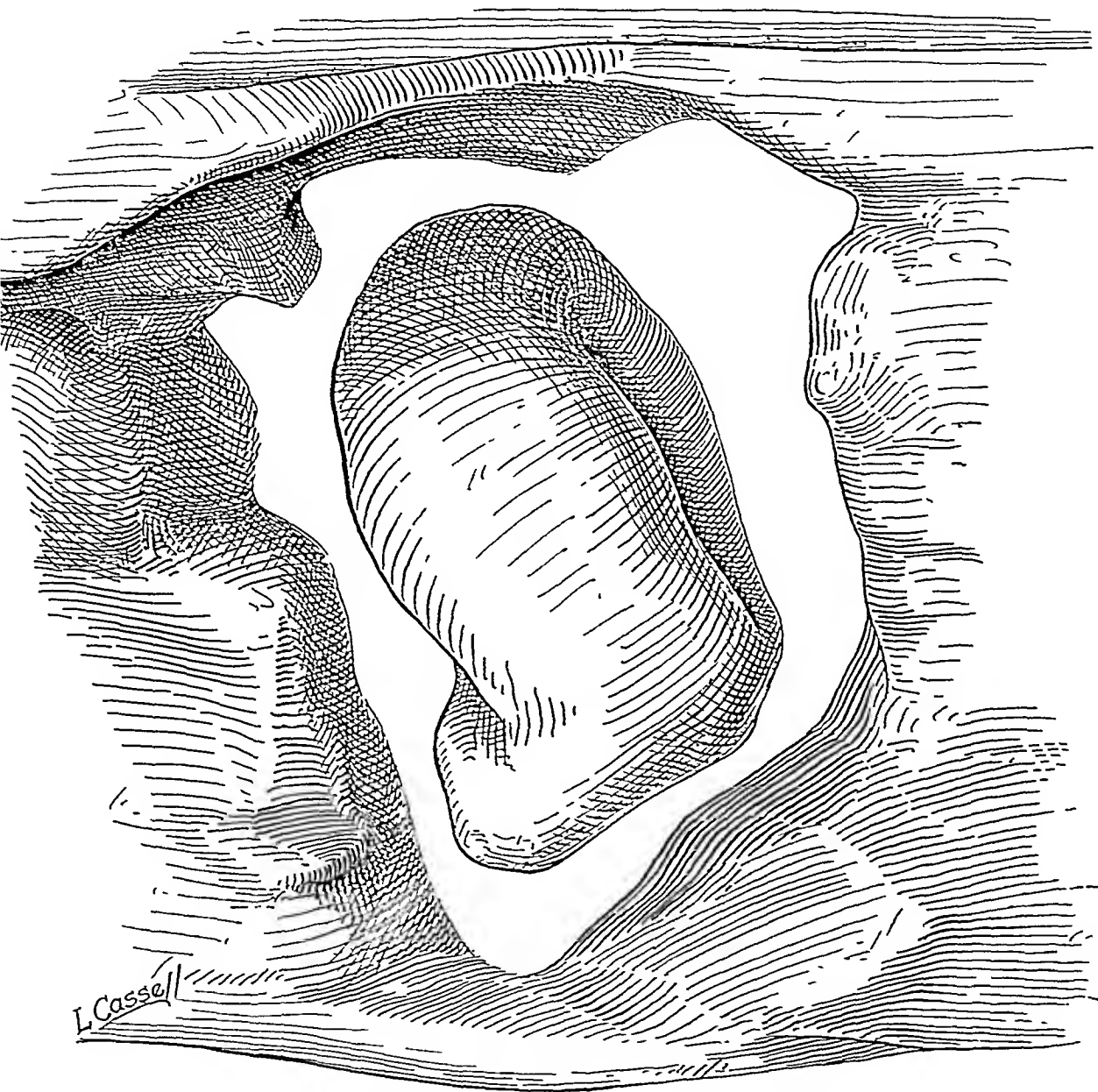


Fig 2—Reconstruction of the stapes and adjacent portion of the vestibular window in embryo of 29 mm,  $\times 214$  (compare fig 5)

its size has increased to approximately one and one-half times that of the stapedial cartilage in the 22.8 mm embryo (table). In general the form is not yet stapedial, although the base and head are beginning to take form as thickened and somewhat flattened areas. Seen from the vestibular aspect the base is slightly irregular, as is that of the surrounding window owing to the rapidity of growth of cartilaginous

tissue (fig 2) The anterior and the posterior crus are of approximately equal size (table) and similar shape and distinguishable as limbs only through their relationship to the capital and basal extremities (fig 5) According to Broman (1898),<sup>5</sup> however, the stapes remains ring shaped up to the second half of the third month of embryonic life

The otic capsule is entirely cartilaginous (Martin and Anson, 1938<sup>6</sup>)

*Embryo of 40 mm Crown-Rump Length (10 Weeks)*—In the 40 mm embryo the stapes has definitely lost its simple form, and is changing from a ring-shaped to a stirrup-shaped structure (fig 6) In length it has increased to two and a quarter times that in the 22.8 mm stage (table) The base of the stapes is irregularly triangular, the apex of the triangle pointing downward (fig 3), its

*Increase in Measurements with the Growth of the Embryo*

Embryo (Crown Rump Length, Mm )	Measurements									
	Stapes		Base				Anterior Crus		Posterior Crus	
	Length Mm	Increase in Length*	Length, Mm	Increase in Length*	Width, Mm		Length Mm	Increase in Length*	Length Mm	Increase in Length
					Anterior	Pos terior				
22 S	0.294		0.218		0.232	0.187	0.292		0.281	
29	0.408	1.39	0.108	1.64	0.24	0.20	0.369	1.26	0.348	1.22
40	0.608	2.27	0.608	2.45	0.78	0.11	0.704	2.41	0.576	2.02
135	2.12	7.89	2.48	10.0	0.904	0.816	2.208	7.51	2.032	7.15
161	2.60	8.84	3.27	13.2	1.072	0.896	2.184	7.74	2.101	7.4
183	2.84	9.67	2.60	10.7	1.176	0.876	2.736	8.68	2.384	8.39

\* Ratio to 22.8 mm embryo

anterior (upper) part has become markedly flattened (fig 6) The capital extremity appears as a slight prolongation Owing to the fact that the head and base are now distinguishable, the crura appear as definite subdivisions of the stapes, set off from the original ring of cartilage by the nodular head and the flattened base, the crura, in

5 Broman, I (a) Ueber die Entwicklung der Gehörknöchelchen beim Menschen, Verhandl d anat Gesellsch **12** 230-236, 1898, (b) Ueber die Entwicklung der Gehörknöchelchen, Monatschr f Ohrenh **25** 65, 1891

6 Martin, J, and Anson, B J Otic Capsule and Membranous Labyrinth of the 29 mm (Crown-Rump) Human Embryo, Arch Otolaryng **27** 279-303 (March) 1938

7 In form and structure the stapes of the 39.5 mm embryo (Carnegie Collection, no 6203) is a virtual duplication of that in the 40 mm stage, as here illustrated in figures 3 and 6 In neither the 69 mm nor the 85 mm embryo in the Carnegie Collection (no 4291 and no 30, respectively) has bone begun to form in the stapes

retaining their curved outline now seem to possess the bowed form which characterizes these parts in the adult. The intercrural space is elongate no longer circular. The capsule, as well as the stapes is entirely cartilaginous. Although more capacious, the vestibular window still retains the roughly triangular form of the earlier stages.

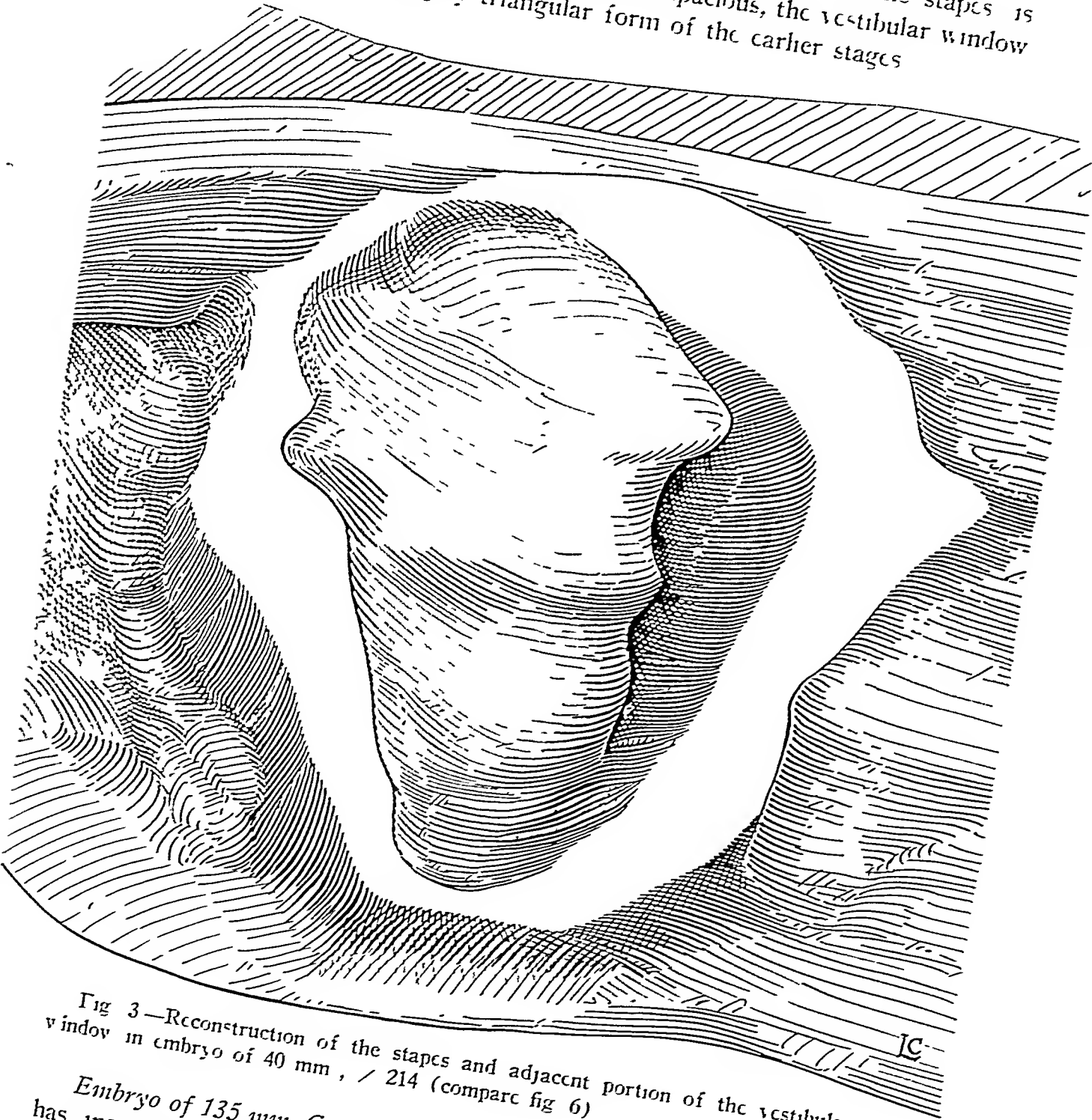
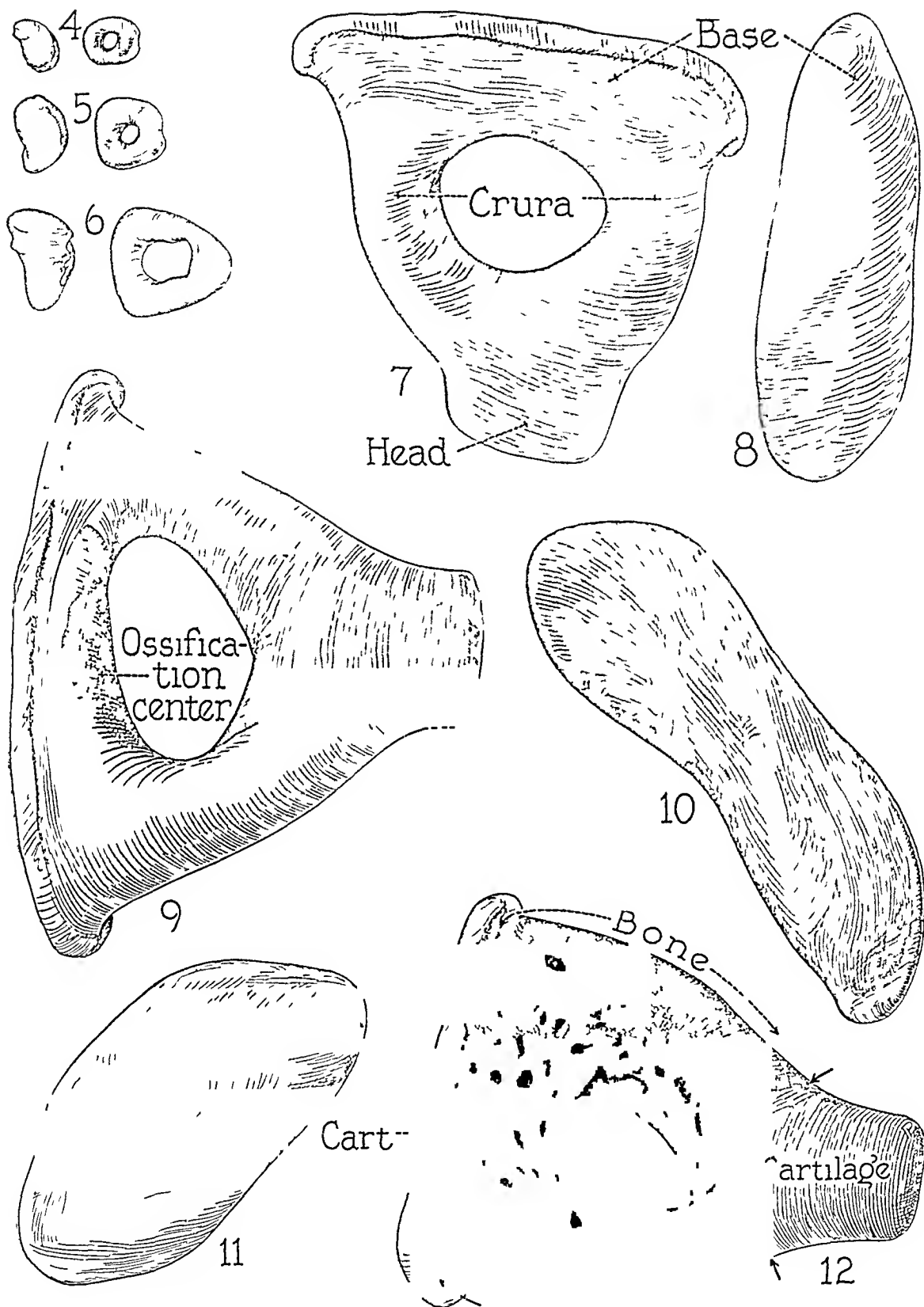


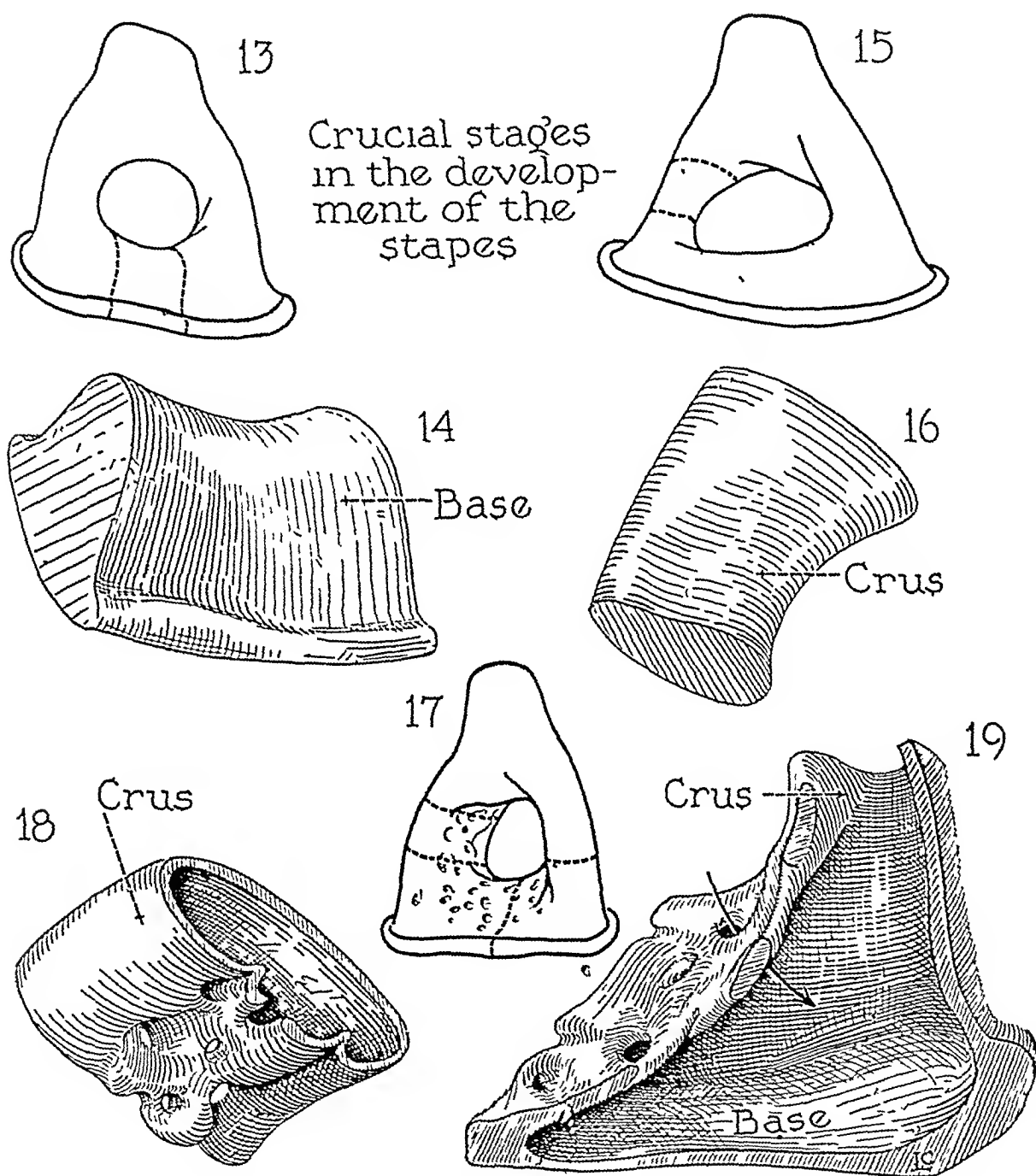
Fig 3—Reconstruction of the stapes and adjacent portion of the vestibular window in embryo of 40 mm, / 214 (compare fig 6)

*Embryo of 135 mm Crown-Rump Length (17 Weeks)*—The stapes has increased considerably in size between the 228 mm and the 135 mm stage both length and breadth are approximately eight times their initial size. The various parts of the stapes are readily identi-



Figs 4 to 12—Reconstructions of the stapes, vestibular and cranial views, in pairs,  $\times 25$  Figure 4, the 228 mm embryo, figure 5, the 29 mm, figure 6, the 40 mm, figures 7 and 8, the 135 mm, figures 9 and 10, the 161 mm, and figures 11 and 12, the 183 mm, *Cart* indicates cartilage

fiable (figs 2, 7 and 8) The base, now flattened, fits in the window closely (figs 24 and 25) and is attached to the window through a definite stapedia ligament (figs 26 and 27)



Figs 13 to 19—Figures 13, 15 and 17, reconstructions of the stapes, embryos of 135, 161 and 183 mm, superior aspect,  $\times 21$  (compare figs 7, 9 and 12 respectively) Figures 14, 16, 18 and 19, segments of these reconstructions taken from the areas indicated in figures 13, 15 and 17,  $\times 42$  Figure 14 represents the middle third of the base (135 mm embryo), figure 16, the middle two fourths of the posterior crus (183 mm embryo), and figure 19, the anterior crus and base (183 mm embryo)



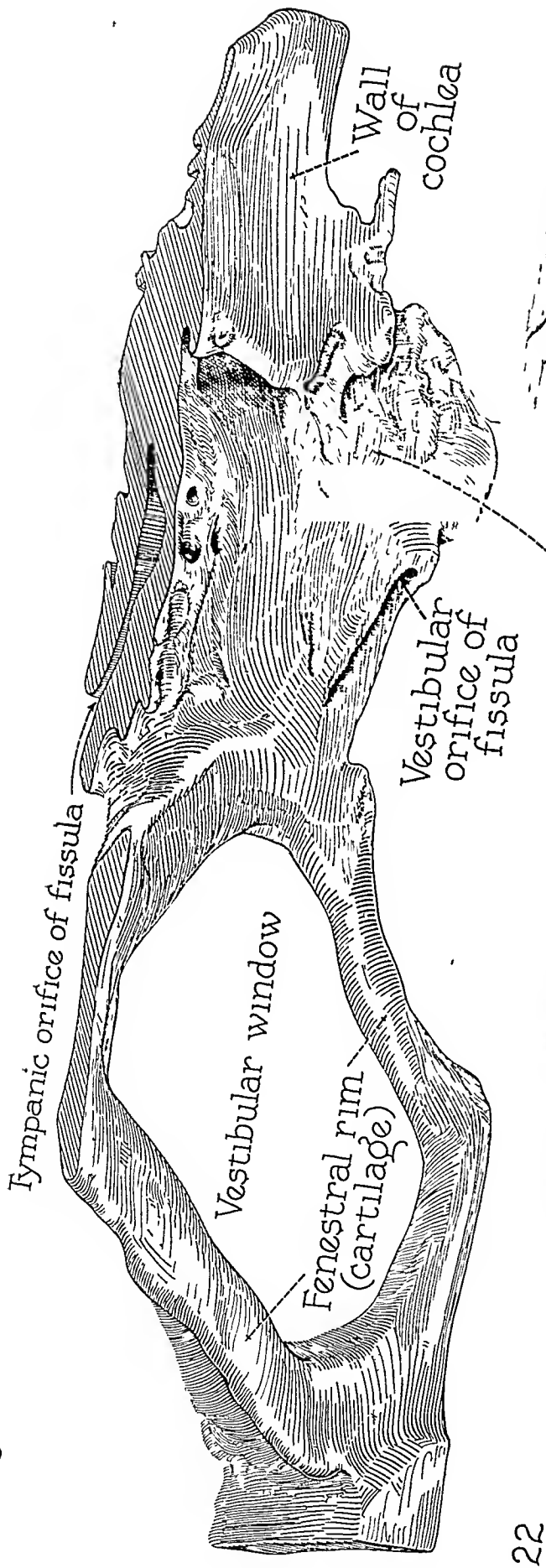
The base, like the remainder of the ossicle, is cartilaginous. The base of the stapes is flattened on its vestibular aspect and narrowed and rounded on its tympanic (figs 13 and 14). It is lipped circumferentially (i. e., where in contact with the window), a condition which is not forecast by the conformation of the stapes in the embryo of 40 mm. The articular surface of the head is hollowed to receive the incus (fig 25). The crura are now dissimilar, the anterior crus being the longer of the two, the crura remain solid cartilaginous bars, as does the base (fig 14). As the crura extend laterally, they turn somewhat downward, they arise from the base nearer its inferior than its superior margin. The intercrural space is oval and its margins smooth.

The labyrinthine capsule above and below the vestibular window projects laterally, within the recess thus bounded the stapes rests. The superior ledge forms the floor of the future facial canal, in which the facial nerve follows an arching course over the vestibular window, anteriorly the same ledge will later form the semicanal for the tensor tympani muscle. The cartilage of the labyrinthine capsule is gradually being replaced by bone (Bast, 1930<sup>2</sup>), one center of ossification now pressing toward the vestibular window (figs 24 and 25).

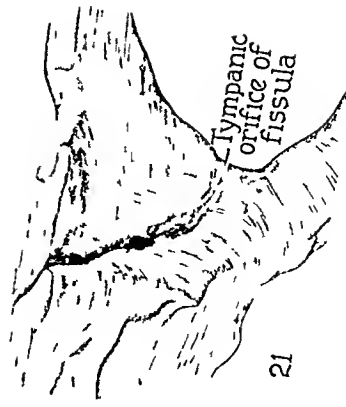
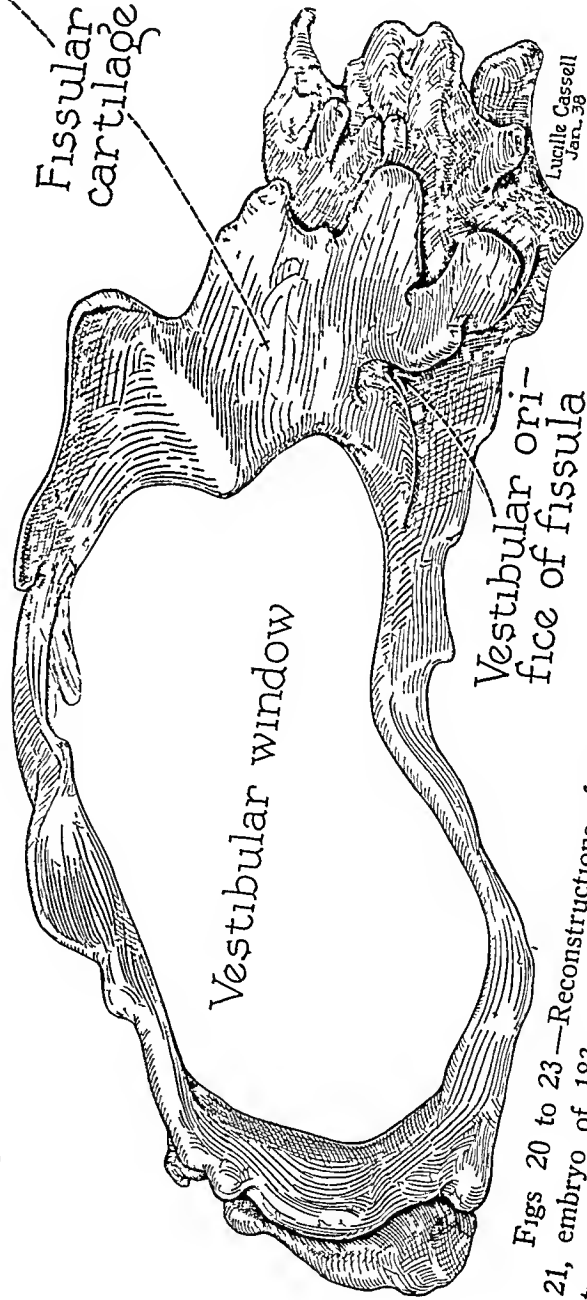
Before the capsule becomes wholly ossified, within it is formed a stripe of connective tissue reaching from the vestibular to the tympanic surface of the lateral wall of the capsule, in front of the vestibular window, this channel, the fissula ante fenestram, was first recognized as a probable opening in the dried bone of the adult. Around the core of connective tissue the primitive cartilage remains in the form of a fenestral rim, as a remnant of the cartilaginous otic capsule. The fissula, according to Bast (1933),<sup>8</sup> is easily discerned in the embryo of 100 mm (14 weeks), when the precartilaginous labyrinthine capsule changes to cartilage, the fissure remains as an area in which the precartilage undergoes a retrograde change, forming vacuolated areolar tissue and later vascular connective tissue. The vestibular orifice is regularly situated near the junction of the scala vestibuli and the vestibular cavity, the tympanic orifice is usually adjacent to the attachment of the annular ligament but occasionally may open into the semicanal for the tensor muscle. In addition to the fissula ante fenestram, a fibrous zone sometimes occurs posterior to the oval window, this is known as the fossula post fenestram. It is histologically similar to the fissula but narrower and shorter. Unlike the fissula ante fenestram, the fossula is an inconstant structure.

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8 Bast, T. H. Development of the Otic Capsule. II. The Origin, Development and Significance of the Fissula Ante Fenestram and Its Relation to Otosclerotic Foci, *Arch. Otolaryng.* 18:1-20 (July) 1933.

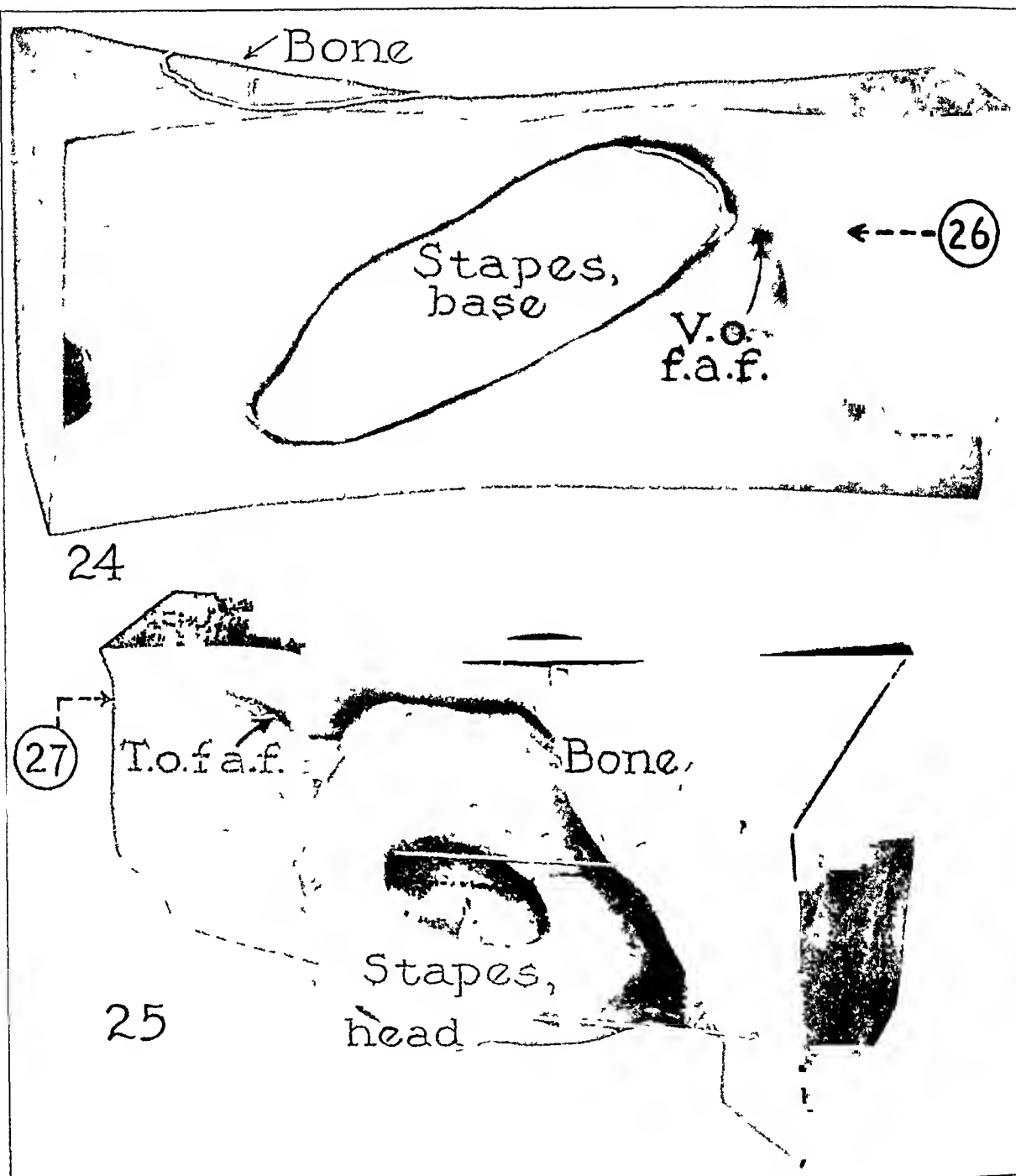


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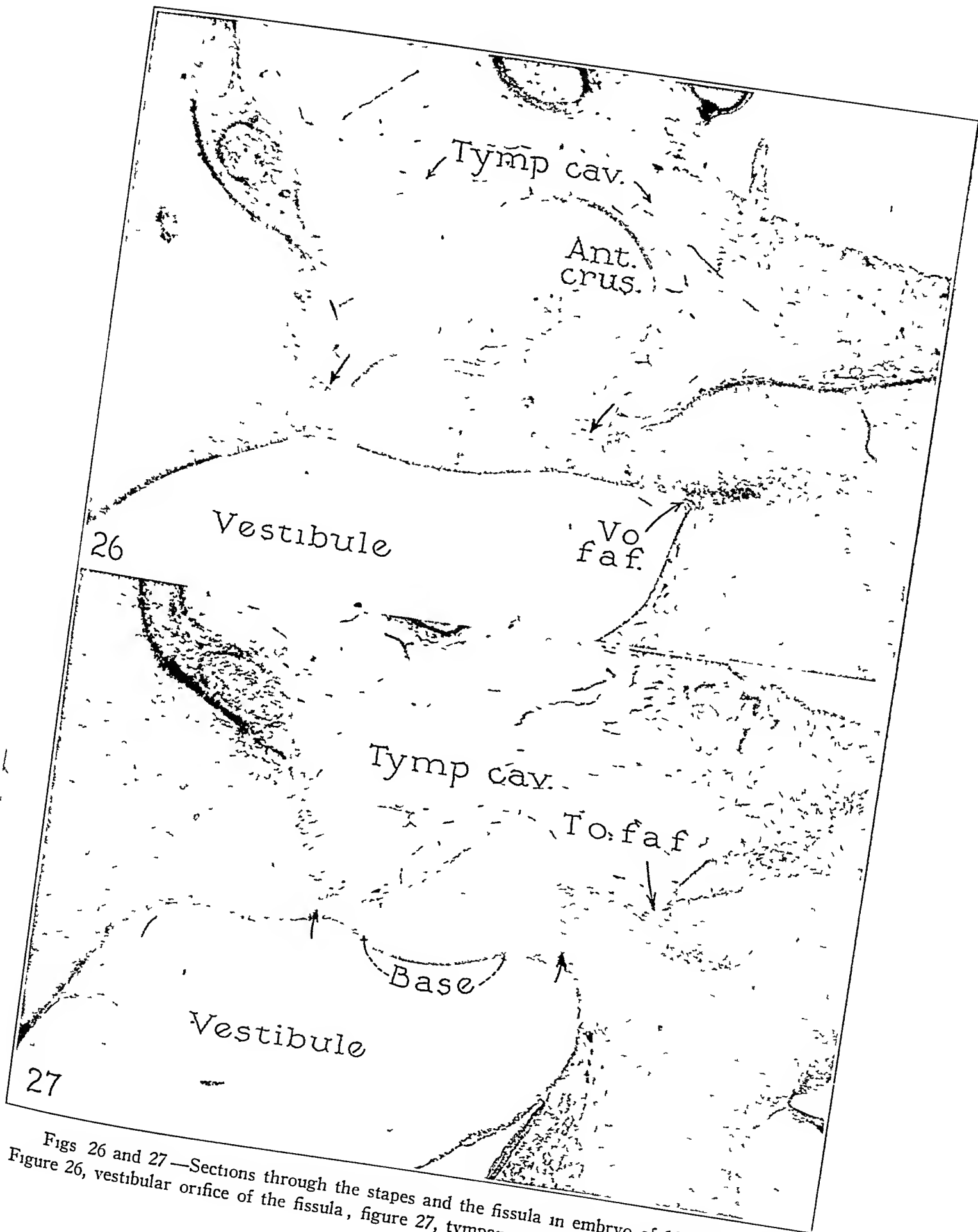
Figs 20 to 23.—Reconstructions of the cartilage surrounding the vestibular window and the fissula ante fenestram, figures 20 and 21, embryo of 183 mm (compare figs 31 and 32, respectively), figures 22 and 23, person 70 years old,  $\times 27$  Figure 21 is a tympanic view, the others vestibular

Lucille Cassell  
Jan. 38



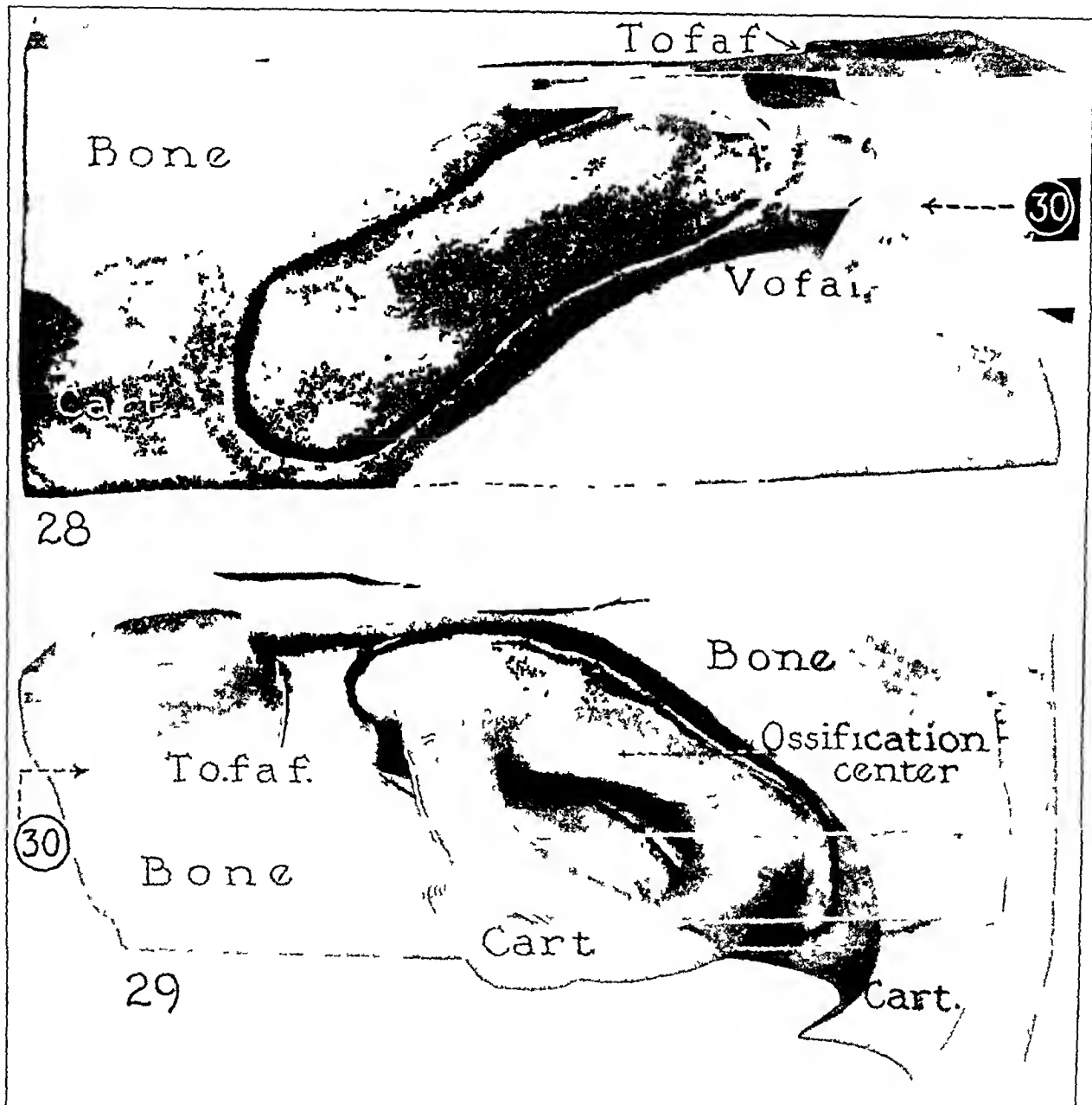
Figs 24 and 25—Reconstruction of the stapes and adjacent portion of the otic capsule in embryo of 135 mm,  $\times 28$ . Figure 24 is the vestibular aspect, and figure 25, the tympanic. The levels of the sections in figures 26 and 27 are indicated by lines correspondingly numbered.

In these and in the succeeding figures *Ant crus* indicates anterior crus, *Cart*, cartilage, *Fen cart*, fenestral cartilage, *Fn*, facial nerve, *Fiss cart*, fissular cartilage, *Muc memb*, mucous membrane, *Tymp cav*, tympanic cavity (future), *To f a f*, tympanic orifice of fissula ante fenestram, and *Vo f a f*, vestibular orifice of fissula ante fenestram.



Figs 26 and 27—Sections through the stapes and the fissula in embryo of 135 mm,  $\times 31$   
 Figure 26, vestibular orifice of the fissula, figure 27, tympanic orifice

A prominent fissula occurs in the present specimen. Its tympanic extremity is a pronounced slit, removed by 0.25 mm from the anterior margin of the oval window (figs 25 and 27), the orifice is 0.2 mm



Figs 28 and 29—Reconstruction of the stapes and the neighboring structures in embryo of 161 mm, showing the primary center of ossification in the stapes,  $\times 23$ . Figure 28, the vestibular aspect, and figure 29, the tympanic. The level of the section in figure 30 is indicated by a correspondingly numbered line.

long and 0.07 mm wide. Its long axis coincides with that of a sulcus in the cartilaginous capsule. The vestibular orifice is 1.6 mm long and 0.07 mm wide (figs 24 and 26), only 0.12 mm intervenes between the

orifice and the adjacent margin of the vestibular window. The opening is continuous with a sulcus which in turn spreads out on the roof of the scala vestibuli. A supernumerary orifice opens directly into the vestibular window, it is 0.1 mm long and 0.05 mm wide.

*Embryo of 161 mm Crown-Rump Length (19½ Weeks)*—The length of the stapes is now eight and one-half to nine times as great as it was in the 22.8 mm embryo (figs 9 and 10, compare fig 4). The outline of the base is somewhat reniform, the edges are smooth. The entire vestibular surface of the base is cartilaginous, but on the tympanic aspect a center of ossification is present (figs 9, 29 and 30). Broman (1891)<sup>5</sup> expressed the belief that ossification began at a later stage (210 mm). The long axis of the center corresponds to that of the head of the stapes. The base, at its fenestral margin, is cupped backward toward the vestibule, forming a prominent circumferential lip (fig 9). It fits the vestibular window snugly (fig 24).

The crura have not undergone striking change in shape. They remain solid cartilaginous masses (figs 15 and 16). The head is acquiring the familiar shape of the adult ossicle, and a definite neck is distinguishable. The articular surface of the head is concave and points slightly downward. Both head and neck are entirely cartilaginous. The intercrural space is not yet triangular in outline. Urbantschitsch (1876)<sup>9</sup> expressed the belief that the ossicles do not attain their definitive size until the time of birth, actually, adult lengths are attained at this stage (161 mm), in midfetal life.

The fissula ante fenestram is now a prominent channel through the cartilaginous otic capsule. The tympanic orifice is situated on the floor of an oblique sulcus (fig 29), deeper than that seen in the preceding stage. The orifice is circular and small, measuring 0.1 mm in diameter, it is removed by 0.6 mm from the anterior margin of the vestibular window. Midway in its course the fissure abruptly expands, after having extended for 1.2 mm beyond the fenestral margin, it turns backward and downward to end at a vestibular orifice (figs 28 and 30) placed 0.4 mm anterior to the window. This also is small, measuring 0.3 mm in length and 0.2 mm in width, it opens on the roof of the scala vestibuli.

On the medial tympanic (fig 29) and the lateral vestibular wall (fig 28), bone has spread toward the vestibular window from above and below, so that only the fenestral area of the capsule in this region remains cartilaginous. On the tympanic wall the bone comes within 0.5 mm of the fenestral opening, on the vestibular wall within 1.8 mm

<sup>9</sup> Urbantschitsch, V. Zur Anatomie der Gehörknochenchen der Menschen, Arch f Ohrenh 2 1-10, 1876.

So restricted, in fact, has the cartilage become that it begins to assume the form of a shell lining the vestibular window—a shell with two extensions, one directed posteriorly and the other anteriorly. The fissula is lodged in the anterior part, entirely embedded in cartilaginous tissue.

*Fetus of 183 mm Crown-Rump Length (21 Weeks)*—Developmental changes taking place between the preceding (161 mm) and the present (183 mm) stage are of a crucial nature, they affect both form and histologic structure of the stapes.

Surprisingly, the stapes is somewhat smaller than the ossicle in the 161 mm embryo, the base is shorter and wider (fig 11, compare fig 10). This difference is apparent also in the earlier reconstructions by Bast (1930, figs 34 and 35) as we have recently observed how-

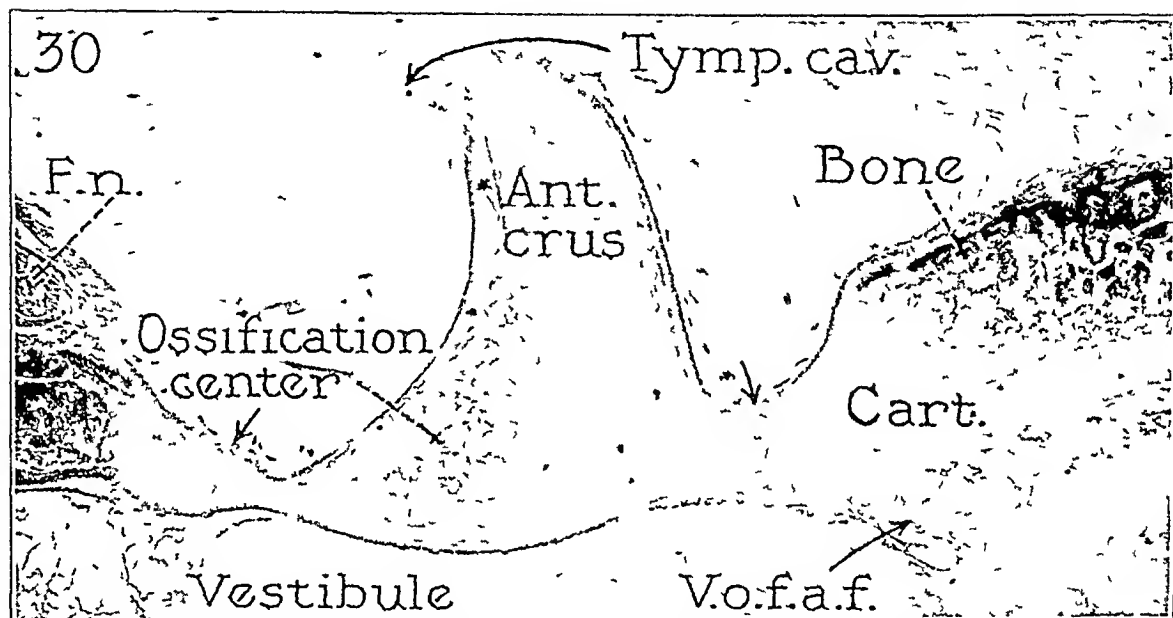


Fig 30—Section through the stapes and the vestibular extremity of the fissula in embryo of 183 mm,  $\times 31$

ever, the adult stapes varies considerably in size, in some cases being smaller than it is in the 19 week embryo.

In form also the stapes of the 183 mm embryo evidences striking changes. The base, at its periphery, is elevated into an even more prominent flangelike projection (fig 12). The crura are not circular in cross section but of flattened oval form, the greater dimension being the vertical one (figs 17 and 18). The compressed surface is that which faces the intercrural space. The head and neck of the stapes are longer, an alteration which renders the configuration distinctly stapodial. The intercrural space is not yet exactly triangular, owing to the manner in which the crura expand gradually at their capital extremities to meet the base.

Although the vestibular portion of the base, its articular rim and the head and neck of the stapes remain cartilaginous (figs 11 and 12), all of the tympanic surface of the base and the two crura have changed to bone (figs 18 and 19). The crura and the base of the stapes, now markedly thinned, are on their internal surface extensively perforate (figs 12, 18 and 19), through these fenestrations pass vessels from the surrounding vascular mesenchyma to the cavity within the stapes (figs 34 and 35). This mechanism of replacement of cartilage brings the stapes into the category of long bones generally, the ossicle being essentially a bone of minute size, in which the original solid cartilaginous bar has been replaced by an osseous shell which encloses a space. The space contains primitive marrow which is supplied by a large number of vessels <sup>10</sup>

As in the preceding stage, the base almost fills the vestibular window and conforms to it closely in outline (figs 31 to 33). The tissue bounding the window is cartilage, a ring of that tissue being visible on the tympanic (figs 32 and 33) and the vestibular (fig 31) surface of the fenestral portion of the capsule. As in the 161 mm embryo this fenestral ring is continuous with a seam of cartilage which extends anterosuperiorly and posteroinferiorly from the vestibular window within the former lies the fissula ante fenestram (figs 20 and 21).

The orifices of the fissula have increased considerably in size. But the growth of the fissula as a whole has not kept pace with that of the otic capsule in which it is lodged, being at this stage only one sixth again as long as it is in the embryo of 161 mm. Such differences are doubtless attributable to individual variation (Anson and Martin 1935, <sup>11</sup> Wilson, 1935 <sup>12</sup> Bast, 1936 <sup>13</sup>). The tympanic opening although incompletely reconstructed, is 0.27 mm long (in the obliquely vertical direction) and 0.01 mm wide, the sulcus from the floor of which the fissure extends into the capsule is more prominent than in the earlier stages (figs 21 and 32). Owing to its oblique course, the posteroinferior limit of the orifice is 0.5 mm removed from the anterior margin of the vestibular window and the anterosuperior limit 0.9 mm therefrom. Within the capsule the fissular space widens somewhat as

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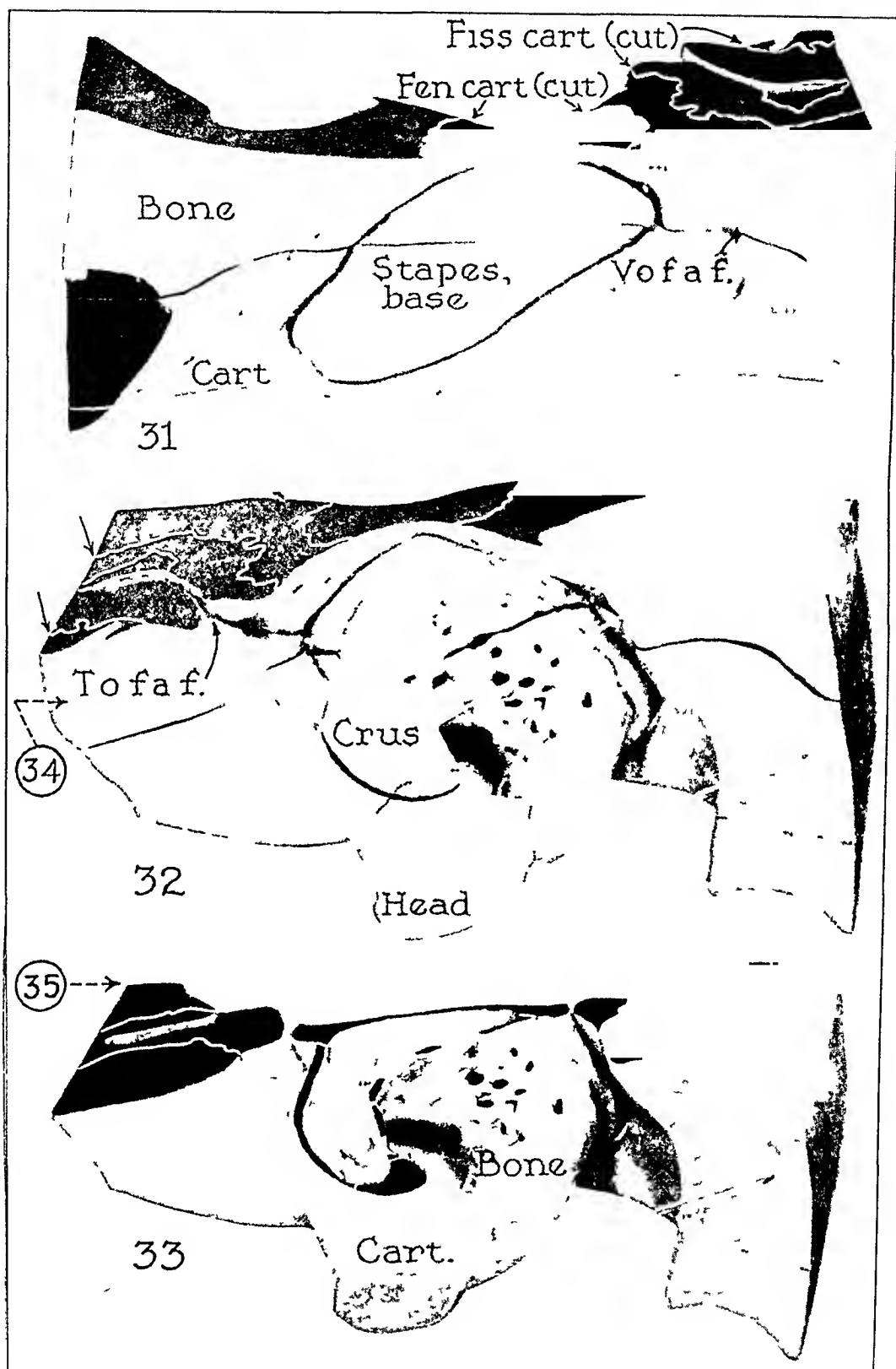
<sup>10</sup> As will be described fully in a later publication, the internal wall of the crus and of the base is ultimately resorbed each part then resembling a long bone of diminutive size one side of which has been destroyed and its marrow tissue replaced by periosteum.

<sup>11</sup> Anson, B. J. and Martin, J., Jr. Fissula Ante Fenestram. Its Form and Contents in Early Life, *Arch. Otolaryng.* **21** 303-323 (March) 1935.

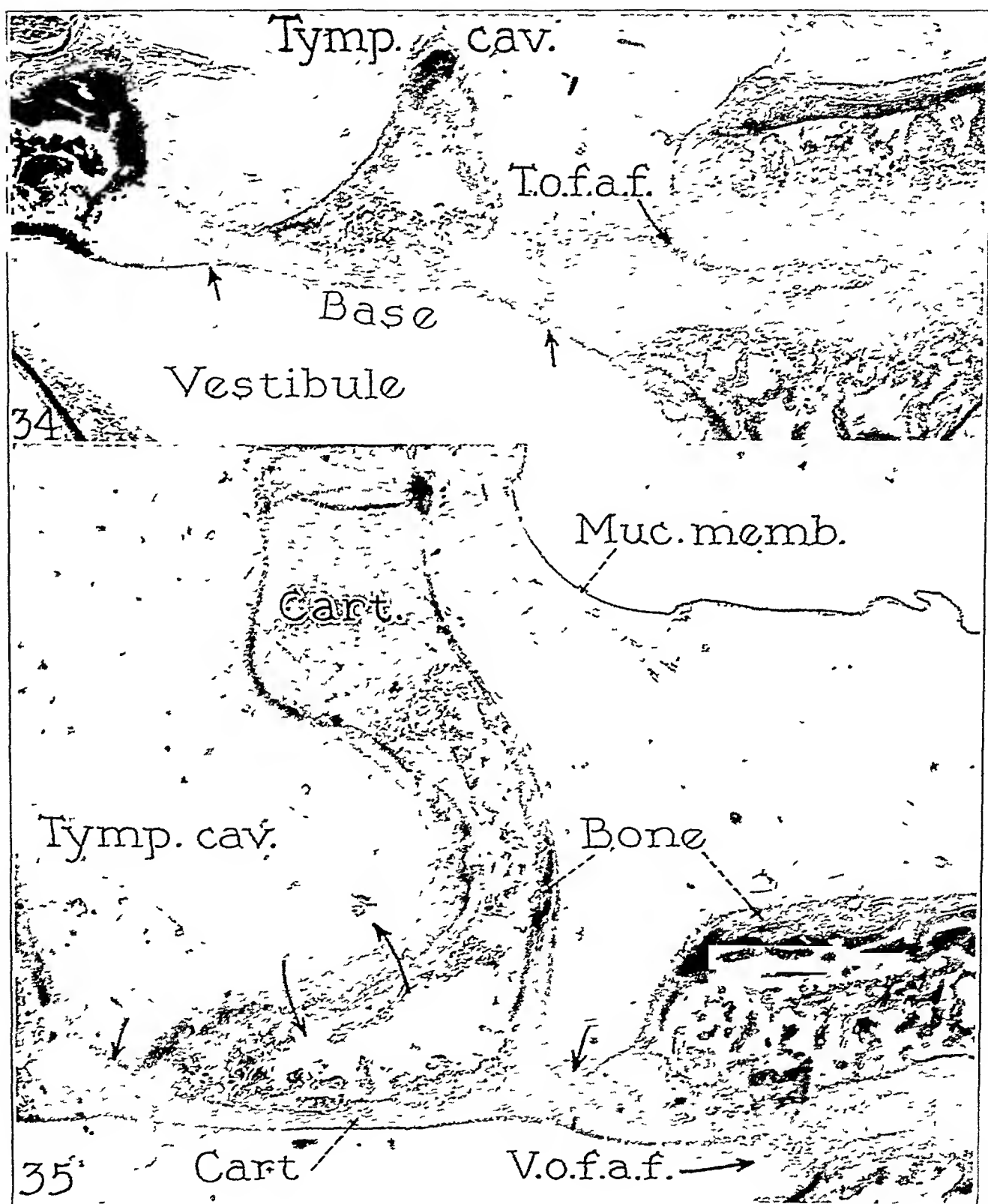
<sup>12</sup> Wilson, J. G. Fissula Ante Fenestram and the Adjacent Tissue in the Human Otic Capsule, *Acta oto-laryng.* **22** 382-389, 1935.

<sup>13</sup> Bast, T. H. Development of the Otic Capsule. III. Fetal and Infantile Changes in the Fissular Region and Their Probable Relationship to the Formation of Otosclerotic Foci, *Arch. Otolaryng.* **23** 509-525, (May) 1936.





Figs 31 to 33—Reconstruction of the stapes and neighboring area in embryo of 183 mm,  $\times 20$  Figure 31, the vestibular aspect, and figures 32 and 33, the tympanic Figure 33 shows the upper section of the reconstruction removed to reveal the cavity within the crura and the base of the stapes The levels of the sections in figures 34 and 35 are indicated by lines correspondingly numbered



Figs 34 and 35—Sections through the stapes and the fissula in embryo of 183 mm ,  $\times 31$   
 Figure 34, the tympanic orifice of the fissula, and figure 35, the vestibular orifice. Curved  
 arrows pass through the fenestrations (compare figs 12 19, 32 and 33)

it extends to a depth of 1.4 mm (fig 33), then, turning backward and downward, it terminates in a vestibular orifice (figs 20 and 31), which, like the corresponding orifice in the preceding specimen, is situated at the junction of the vestibule and the scala vestibuli, it is removed 0.3 mm from the window. The vestibular orifice is elongate, being 0.7 mm long and 0.1 mm wide (fig 20). Throughout its course, from tympanic to vestibular orifice, the connective tissue lies within cartilage (figs 34 and 35, compare fig 20).

A fossula post fenestram is present.

In this specimen bone has replaced cartilage to such an extent that the latter tissue remains only in the general region of the vestibular window. Anteriorly, the cartilage reaches the cochlea, part of whose wall it forms (fig 20).

This elongate seam of cartilage, which now constitutes a relatively small part of the lateral wall of the otic capsule, represents in reduced form that larger mass which, at the 135 mm stage, makes up a considerable part of the fenestral area (figs 24 and 25, compare Bast, 1930<sup>2</sup>). Encroached on by bone from above and below, the mass persists as a rim surrounding the vestibular window, it extends anterosuperiorly to enclose the fissula (figs 20 and 21) and postero-inferiorly to include the fossula, it assumes the form of an oval shell with two bulbous enlargements, a larger fissular and a smaller fossular part. Viewed as a whole, then, it may be said to be the cartilaginous remnant which encloses the three orifices in the lateral capsular wall—one, an oval window in which rests the stapes and the other two, small fissure-like communications, each filled with vascular connective tissue. The entire mass lies in an oblique plane which coincides with the long axis of the stapes itself. Further encroached on by bone as embryonic development and adult alteration progress, it retains more than a semblance of its original form even in persons of advanced age (figs 22 and 23).

As will be shown in a later publication, the cartilage is soon replaced by bone at the cochlear extremity, the anterior part of the mass then persisting as a shell for the fissula, not as a mass between fenestral area and cochlea. Gradually reduced in amount, that part which surrounds the tympanic end of the fissula may be totally obliterated in the adult, no trace of it remaining within the bone of the tympanic wall, while that which encloses the vestibular end regularly persists (figs 22 and 23), whether slight or massive, histologically it remains a typical hyaline cartilage. One might therefore describe the fissular area as one in which histogenetic changes occur slowly, the primitive cartilaginous tissue retains potentialities for growth, the newly formed tissue derived from the original cartilage sometimes replacing the connective tissue of

the fissula and even protruding from the normal orifices of the fissula (Anson and Martin, 1935,<sup>11</sup> figs 67 to 69, Bast, 1936,<sup>13</sup> figs 47 to 50)

In the infant, the child and the adult either orifice of the fissula may open into a sulcus in the bone (Anson and Martin, 1935,<sup>11</sup> fig 1), the tympanic sulcus is frequently rather elongate, curving downward and backward toward the anterior margin of the vestibular window. The presence of such a sulcus is foreshadowed in the present stage (fig 32) as it is also in the preceding one (161 mm, fig 29). A less pronounced sulcus is present at the vestibular extremity (figs 31 and 28). In the adult and even in the infant and child, the vestibular orifice is regularly longer than the tympanic (Anson and Martin, 1935,<sup>11</sup> figs 2, 6, 10, 15, 18, 22 and 28), this condition is not forecast in the embryonic stages (135, 161 and 183 mm), in which the cleft is still totally surrounded by cartilage, it is probably established when bone encroaches on the fissular cartilage.

#### CONCLUSIONS

The stapedial cartilage is clearly defined in the embryo of 22.8 mm, at this stage it possesses the form of a ring, not that of a stirrup. At the 40 mm stage its constituent parts are distinguishable, the somewhat flattened base being set off from the bowed crura, no true neck and head are present. Between the 40 and the 135 mm stage pronounced changes have occurred, which convert the simple structure into one definitely stirrup-like. In the 135 mm embryo the stapes is still cartilaginous, but at the 161 mm stage a center of ossification has formed, situated in the basal portion. Remarkably enough, while still almost entirely chondral, the stapes comes close to attaining adult size. The stapes is a far more bulky structure at this stage than it is in the adult. Irregular in outline in earlier stages, the margin of the base is smooth in the embryo of 135 mm.

The base of the stapes has attained adult size and shape in the embryo of 161 mm, but it is destined to undergo series of structural changes throughout life. In the 22.8, the 29 and the 40 mm stage the base is cartilaginous. At the 161 mm stage the first center of ossification has appeared on the tympanic surface of the base, thereafter changes in structure occur rapidly. The bulky base becomes hollowed and acquires a marrow cavity and a fenestrated internal surface, the vestibular layer remains cartilaginous. In later stages the fenestrated internal wall disappears, and the base is reduced to a relatively flat plate, cartilaginous on the vestibular and osseous on the tympanic surface.

The crura also reach their definitive size in the 161 mm embryo. Their development may be likened to that of any long bone. They are at first solid cartilaginous structures, cartilage is then invaded by

vascular osteogenic buds, which gradually resorb the embryonic cartilage, beginning at the base and spreading toward the head. This resorption progresses so rapidly that in the 183 mm embryo the crura are hollow bony cylinders, perforated by vessels along their concave (internal) surface. The crura contain a marrow cavity continuous with that of the base.

The head and neck are ossified later than the crura, they are still cartilaginous in the 183 mm embryo. The osseous tissue develops from a single center, situated on the tympanic aspect of the base in the 161 mm embryo, and spreads therefrom along the base and the crura until cartilage finally remains only on the vestibular aspect of the base and the head and neck of the ossicle, concurrently the osseous portions are hollowed, and there is a continuous cavity filled with marrow-like tissue, the appearance is that of a long bone, diminutive in size, with a cartilaginous articular extremity. On the internal surface of the base, the bone, like that of the corresponding aspect of each crus, is riddled by vascular hiatuses, the openings suggesting multiple nutrient foramina, the external surface of the crus is smooth bone, while that of the vestibular surface of the base is unaltered cartilage. Intrinsic spaces within the base and the crura—haversian spaces—are not yet present, in older specimens these traverse the bone and communicate with vessels in the subepithelial tissue.

The vestibular window reaches its definitive shape and size in the embryo of 161 mm, at that stage conforming to the shape of the base of the stapes. The shape of the window in the earlier stages is irregularly triangular, the base of the stapes being relatively much smaller than the fenestral space. As early as the 183 mm stage, changes toward the adult form occur, the posterior half of the vestibular window remains flattened and in close proximity to the posterior surface of the base, while the anterior half becomes sharp and tapered, thereby causing an overhanging of the base on the tympanic surface of the labyrinthine capsule. The vestibular window is lined by a rim of cartilage throughout life, this fenestral cartilage decreases as age advances, the cartilaginous rim in the 70 year old person being approximately one half as thick as that in the 183 mm embryo, yet the cartilage of this articular surface is never wholly replaced by bone.

The fissula ante fenestram and the fossula post fenestram (when present) are surrounded by cartilage which is directly continuous with the vestibular cartilaginous rim. The entire mass thus formed is larger at the anterior than at the posterior extremity, since the fissular investment of cartilage is thick in fetal stages. The fissula has not appeared in the 40 mm embryo but is present in the one of 135 mm. In all cases the tympanic extremity of the fissula ante fenestram is placed

more superiorly than is the vestibular, the latter is usually the larger of the two and the closer to the vestibular window, there may be a third extremity opening directly into the vestibular window. The embryonic cartilaginous shell of the fissula persists, in part at least, throughout life.

The fossula post fenestram, an inconstant channel situated posterior to the vestibular window, occurred in but 1 of the 3 older specimens studied, here it lay within a posterior projection of the fenestral shell of cartilage, which was considerably smaller than the chondral covering for the fissula in the same specimen.<sup>14</sup>

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14 Since the present paper left the author's hands, an excellent account of the fossula post fenestram, by Professor T. H. Bast, has appeared in the April 1938 issue of the *ARCHIVES* pages 402 to 412. In development and in structure the fossula was discovered to be generally similar to the fissula ante fenestram, being an evagination of vestibular tissue into the bony capsule. But, less frequent in occurrence than the fissula, the fossula was present in 67 per cent of the ears studied, in 25 per cent of the ears possessing a fossula, the channel was complete, that is, extended from the vestibule to the tympanic cavity, in 16.7 per cent, it opened on the tympanic cavity only, in the remaining 73.3 per cent, the opposite, or vestibular, orifice alone was found.

# USE OF SULFANILAMIDE IN OTOLARYNGOLOGY

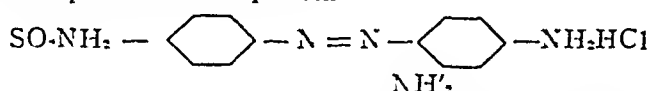
## A REVIEW OF THE LITERATURE

HARRY P. SCHENCK, M.D.

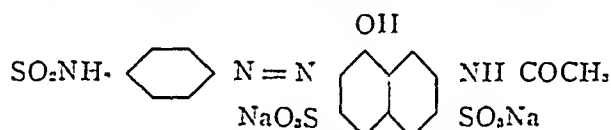
PHILADELPHIA

### DEFINITION OF TERMS

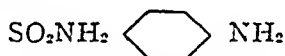
The original prontosil, the hydrochloride of 4-sulfamido-2', 4'-diaminazobenzene, is an azo dye. This red crystalline powder has a melting point of 247 to 251 C and is soluble in water up to about 0.25 per cent.



Prontosil soluble<sup>1</sup> is a 2.5 per cent watery solution of disodium-4-sulfamido-phenyl-2'-azo-7'-acetyl-amino-1'-hydroxynaphthalene-3', 6'-disulfonate, which is a reddish crystalline material and soluble up to about 4 per cent in water.



Sulfanilamide was selected by the Council on Pharmacy and Chemistry of the American Medical Association as the name for paraaminobenzenesulfonamide. This white crystalline powder has a melting point of 165 C and is soluble in water up to about 1 per cent.



In citations of the literature, the foregoing terminology has been adhered to wherever it has been possible to determine which preparation was used. When the term "prontosil" was used in a report and no information permitting identification of the particular preparation was given, a parenthetical statement has been inserted to that effect.

### INTRODUCTION

Although considerable confusion still exists concerning the therapeutic usefulness of sulfanilamide and its related compounds, a wealth of experimental and clinical data has accumulated. The following review of the literature deals only with those problems which are of interest to the otolaryngologist but necessarily includes experience gained in the laboratory and in other fields of medicine.

### HISTORICAL SURVEY

In 1908 Gelmo,<sup>1a</sup> while working on the chemistry of azo dyes, as stated by Schulte,<sup>2</sup> first mentioned paraaminobenzenesulfonamide. The

1 Recently the manufacturer has adapted the name neoprontosil for this substance, and the Council on Pharmacy and Chemistry of the American Medical Association has concurred.

sulfonamide grouping was first incorporated in azo dyes by Hoeilein, Dressel and Kothe,<sup>3</sup> who also substituted sulfonamido groups, it was noted at that time that the ability of these dyes to enter into intimate combination with wool proteins is greater than that of similar dyes free from sulfonamide.<sup>4</sup> In 1911, Sisley and Porcher<sup>5</sup> demonstrated that bacterial action in the intestine breaks down chrysoidine (diaminoazobenzene hydrochloride), which splits at the double bond. As early as 1913, Eisenberg<sup>6</sup> observed the bactericidal power of certain azo dyes *in vitro* and considered the possibility of employing chrysoidine in therapeutics.

In 1914, chrysoidine being used as a basis for the work,<sup>2</sup> pyridium (benzeneazo- $\alpha$ - $\alpha$ -diaminopyridine hydrochloride) was synthesized.<sup>7</sup> The synthesis of toluylazotoluylazo- $\beta$ -naphthol and diacetylaminooztoluene followed.<sup>8</sup> Accomplishing the synthesis of metaaminobenzenesulfonamide, metaacetylaminobenzenesulfonamide and parachloroacetylaminobenzenesulfonamide in 1917, Jacobs and Heidelberger<sup>9</sup> turned their attention to azo dyes derived from hydrocupreine and hydrocupreidine<sup>10</sup> and demonstrated that hydrocupreine and hydrocupreidine yield well defined azo dyes with diazotized aromatic amines. They subsequently synthesized paraaminobenzenesulfonamideazohydrocupreine, metaaminobenzenesulfonamideazohydrocupreine and parabenzenesulfanilicazohydrocupreine and noted that many of these substances were bactericidal *in vitro*.

1a Gelmo, P. Ueber Sulfamide der p-Amidobenzolsulfonsaure, *J f prakt Chem* **77** 369 (April 3) 1908

2 Schulte, T. L. History of the Development of Sulfanilamide, *Proc Staff Meet*, Mayo Clin **13** 53 (Jan 26) 1938

3 Cited by Hoerlein, H. New Class of Chemotherapeutic Agents Against Streptococci, with Special Reference to Prontosil and Prontylin, *M Rec* **146** 11 (July 7) 1937

4 Welch, A. DeM. The Pharmacologic Basis for Sulfanilamide Therapy, *J Pediat* **11** 159 (Aug) 1937

5 Sisley, P., and Porcher, C. Du sort des matières colorantes dans l'organisme animal, *Compt rend Acad d sc* **152** 1062, 1911

6 Eisenberg, P. Untersuchungen uber halbspezifische Desinfektionsvorgange, *Centralbl f Bakt (Abt 1)* **71** 420, 1914

7 Tchichibabin, A. E., and Zeide, O. A. *Zhur russk fiz-khim Obsh* **46** 1216, 1914

8 Collins, G. W. Chemical Examination of "Pyridium" and "Mallophone," *J Am Pharm A* **20** 455 (May) 1931

9 Jacobs, W. A., and Heidelberger, M. Amides, Uramino Compounds and Ureides Containing an Aromatic Nucleus, *J Am Chem Soc* **39** 2418 (Nov) 1917

10 Heidelberger, M., and Jacobs, W. A. Syntheses in the Cinchona Series III. Azo Dyes Derived from Hydrocupreine and Hydrocupreidine, *J Am Chem Soc* **41** 2131 (Dec) 1919



An azo dye synthesized for the dye industry in 1932 by Mietzsch and Klarer<sup>3</sup> was used experimentally in the same year in the treatment of streptococcic infections in mice by Domagk<sup>11</sup>. This drug (the hydrochloride of 4-sulfamido-2', 4'-diaminoazobenzene) was the original preparation called prontosil. The observations of Domagk in 1935 indicated the therapeutic possibilities of azo compounds containing the sulfonamide radical in the para position, and his work in animals was partially or completely confirmed by subsequent investigators<sup>12</sup>.

The first report of the clinical use of these products was that of Foerster<sup>13</sup> in 1933. He reported the survival and cure of an infant with perifolliculitis and staphylococcic septicemia when prontosil soluble (streptozon) was administered. In 1934, Grutz<sup>14</sup> reported the cure of exudative erythema multiforme by the use of the original prontosil (D 5214) and described the effectiveness of the original prontosil administered by mouth and of prontosil soluble administered by the intravenous route in certain cases of toxic and septic erythema<sup>15</sup>.

Up to 1935 no experimental data concerning the prontosils had been reported<sup>16</sup> but with Domagk's<sup>11</sup> report on the use of the original prontosil in the treatment of experimental streptococcic infections of mice clinical papers dealing with the use of the dyes in various types of infectious processes appeared. In general, good therapeutic results were obtained with the use of the original prontosil in tablets and in

11 Domagk, G. Ein Beitrag zur Chemotherapie der bakteriellen Infektionen. *Deutsche med Wchnschr* **61** 250 (Feb 15) 1935.

12 (a) Trefouel, J., Trefouel, J. (Mme.), Nitti, F., and Bovet, D. Activite du p-amino-phenylsulfamide sur les infections streptococciques experimentales de la souris et du lapin, *Compt rend Soc de biol* **120** 756 (Nov.) 1935. (b) Levaditi, C., and Vaisman, A. Action curative du chlorhydrate de 4-sulfamido-2-4-diaminoazobenzene et de quelques derives similaires, dans la streptococcie experimentale, *ibid* **119** 946, 1935. (c) Nitti, F., and Bovet, D. Action du 4-sulfonamide-2-4-diaminobenzol (prontosil) sur des infections streptococciques de la souris provoques par des streptocoques d'origine humaine, *ibid* **119** 1277, 1935. (d) Hoerlein, H. Mangelhafter Schutz deutschen geistigen Eigentums auf therapeutischem Gebiet, *Deutsche med Wchnschr* **61** 1090 (July 5) 1935. (e) Colebrook, L., and Kennv, M. Treatment of Human Puerperal Infections, and of Experimental Infections in Mice, with Prontosil, *Lancet* **1** 1279 (June 6) 1936. (f) Long, P. H., and Bliss, E. A. Para-Aminobenzenesulfonamide and Its Derivatives. Experimental and Clinical Observations on Their Use in the Treatment of Beta-Hemolytic Streptococcic Infection, Preliminary Report, *J. A. M. A* **108** 32 (Jan 2) 1937.

13 Foerster, L. Sepsis in Anschluss an ausgedehnte Periporitis Heilung durch Streptozon, *Zentralbl f Haut- u Geschlechtskr* **45** 549, 1933.

14 Grutz, O. Beitrag zur Kenntnis der infektiös-toxischen, Erythema-exsudativum-multiforme-ähnlichen Exantheme, *Med Klin* **30** 52 (Jan 12) 1934.

15 Grutz, O. Erythema exsudativum bullosum faciei, colli et extremitatum, *Zentralbl f Haut- u Geschlechtskr* **49** 300, 1934.

16 Long, P. H., and Bliss, E. A. The Clinical Use of Sulfanilamide and Its Derivatives in the Treatment of Infectious Diseases, *Ann Int Med* **11** 575 (Oct) 1937.

solution in the treatment of streptococcic thrombophlebitis, adenitis, otitis media, erysipelas, puerperal sepsis and infectious arthritis<sup>17</sup> Numerous communications followed in the German literature, the use of the original prontosil in tablets and in solution appeared to produce good results in the treatment of infections with *Escherichia coli*,<sup>18</sup> in pneumococcic and staphylococcic infections,<sup>19</sup> in Hodgkin's disease,<sup>20</sup> in sepsis<sup>21</sup> and especially in all cases of pure streptococcic and puerperal sepsis<sup>22</sup> Schreus<sup>17b</sup> and Fuge<sup>22</sup> expressed the opinion that staphylococcic infections were not benefited Roth<sup>23</sup> recognized the value of the new drugs in dealing with hemolytic streptococcic infections, and Schranz<sup>24</sup> reported on a series of 60 patients with sepsis, of whom 57 recovered under treatment with the original prontosil Three of 9 patients with purulent meningitis recovered when treated with prontosil (preparation not stated) by Riecke<sup>25</sup> Good results from the use of the original prontosil and of prontosil soluble in 23 cases of erysipelas were reported by Kramer,<sup>26</sup> and Scherber<sup>27</sup> used the original prontosil in the treatment of pemphigus vulgaris

The first clinical report in France appeared in 1935 In that year, Girard<sup>28</sup> synthesized a compound (sulfonamidochrysoidine, also called rubiazol or French prontosil), which was apparently identical with the

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17 (a) Klee, P, and Romer, H Prontosil bei Streptokokkenkrankungen, *Deutsche med Wchnschr* **61**:253 (Feb 15) 1935 (b) Schreus, H T Chemo-therapie des Erysipels und anderer Infektionen mit Prontosil, *ibid* **61** 255 (Feb 15) 1935 (c) Anselm, E Unsere Erfahrungen mit Prontosil bei Puerperalfieber, *ibid* **61**:264 (Feb 15) 1935 (d) Gantenberg, R, abstracted, *ibid* **61**:284 (Feb 15) 1935

18 Imhauser, K Ueber die Behandlung septischer Erkrankungen mit Prontosil, *Med Klin* **31** 282 (March 1) 1935

19 Recknagel, K Erfahrungen mit Prontosil, *Munchen med Wchnschr* **82** 704 (May 2) 1935

20 Bingold, K Erfolgreiche Behandlung von Hodgkin-Wechsel-Fieber mit Prontosil, *Munchen med Wchnschr* **82** 871 (May 30) 1935

21 Einhauser, K Sepsisbehandlung mit Prontosil, *Munchen med Wchnschr* **82** 1263 (Aug 2) 1935, *Deutsche med Wchnschr* **61** 1463 (Sept 6) 1935

22 Fuge, K Die Behandlung der Puerperalsepsis mit Prontosil, *Deutsche med Wchnschr* **61** 1672 (Oct 18) 1935

23 Roth, A Heilung eines Falles von Streptokokkensepsis unter Prontosilbehandlung, *Deutsche med Wchnschr* **61**:1734 (Oct 25) 1935

24 Schranz, H Zur Sepsisbehandlung mit Prontosil, *Munchen med Wchnschr* **82** 419 (March 14) 1935

25 Riecke, H Zur Therapie der Meningitis, *Ztschr f Hals-, Nasen- u Ohrenh* **38** 175, 1935

26 Kramer, W Ueber Erfahrungen bei der Erysipelbehandlung mit Prontosil, *Munchen med Wchnschr* **83** 608 (April 10) 1936

27 Scherber, G Die Behandlung des Rotlauf mit interner Prontosiltherapie kombiniert mit intravenösen Omnadinjektionen, *Wien med Wchnschr* **85**:783 (July 6) 1935, Zur Behandlung der verschiedenen Formen des Pemphigus chronicus mit Antileprol und Prontosil, *ibid* **86** 22 (Jan 4) 1936

28 Girard, cited by Levaditi and Vaisman<sup>29a</sup>

original German prontosil. The same year, Levaditi and Vaisman<sup>29</sup> confirmed the results of Domagk<sup>11</sup> concerning its bactericidal power for streptococci. Administered by mouth and intravenously, this drug was used by Vermelin and Hartemann<sup>30</sup> in the treatment of puerperal sepsis, and Floch<sup>31</sup> reported good results in the treatment of tropical streptococcic lymphangitis when the drug was administered by mouth. In studying its effects on the kidney damaged by acute hemorrhagic nephritis, Lemierre, La Porte, Laudat and Daum<sup>32</sup> concluded the drug did not increase the existing renal impairment. Reporting its effects in 150 cases of erysipelas, Meyer-Heine<sup>33</sup> concluded that the chemical was a chemotherapeutic agent of great value. Bloch-Michel, Conte and Durel<sup>34</sup> reported favorable therapeutic effects in the treatment of erysipelas with paraaminobenzenesulfonamide (now known as sulfamidamide) and benzylparabenzenesulfonamide.

In England, Colebrook and Kenny,<sup>12c</sup> in 1936, first reported their experimental and clinical experience with the preparation of Girard (supposedly identical with the original prontosil) and with prontosil soluble. After preliminary experiments with mice, they utilized these drugs in the treatment of puerperal fever, observing not only a remarkable therapeutic effect but a definite decrease in the mortality of the patients so treated.

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29 Levaditi, C., and Vaisman, A. (a) Action curative et preventive du chlorhydrate de 4'-sulfamido-2, 4-diamino-azobenzene dans l'infection streptococcique experimentale, *Compt rend Acad d sc* **200** 1694 (May 13) 1935, (b) Mecanisme de l'action curative et preventive du chlorhydrate de 4'-sulfamido-2,4-diaminoazobenzene et d'autres derives similaires dans l'infection streptococcique, experimentale, *Compt rend Soc de biol* **120** 1077 (Dec) 1935, (c) Action curative et preventive du chlorhydrate de 4'-sulfamido-2,4-diaminoazobenzene et de quelques derives similaires dans la streptococcie experimentale, *Presse med* **43** 2097 (Dec 25) 1935.

30 Vermelin, H., and Hartemann, D. De l'emploi du chlorhydrate de sulfamido-chrysoïdine en injections intraveineuses dans le traitement d'I.P., *Bull Soc d'obst et de gynec* **25** 158 (Feb) 1936.

31 Floch, H. Le traitement de la lymphangite endémique des pays chauds par le chlorhydrate de sulfamido-chrysoïdine, *Bull Soc path exot* **29** 165, 1936.

32 Lemierre, A., Laporte, A., Laudat, M., and Daum, S. Nephrite erysipelateuse. Action du bicarbonate de soude ingere sur l'acidose. Innocuite du chlorhydrate de sulfamido-chrysoïdine pour le rein malade, *Bull et mem Soc med d hôp de Paris* **52** 535 (April 6) 1936.

33 Meyer-Heine, A., and Huguenin, P. Traitement de l'erysipele par le chlorhydrate de sulfamido-chrysoïdine, *Presse med* **44** 454 (March 18) 1936.

34 Bloch-Michel, H., Conte, M., and Durel, P. L'emploi des derives sulfamides non azoïques dans le traitement de l'erysipele, *Presse med* **44** 1583 (Oct 10) 1936.

Schulte<sup>2</sup> stated that in 1935 the Tréfouels, Nitti and Bovet,<sup>35</sup> collaborating with Fourneau,<sup>36</sup> recalled the hypothesis advanced in 1919 by Heidelberger and Jacobs<sup>10</sup>. They postulated that Girard's sulfonamidochrysoidine was broken down in the tissues to triaminobenzene and paraaminobenzenesulfonamide, which they assumed to be the pharmacologically effective portion of the prontosil molecule. Thus, paraaminobenzenesulfonamide (now known as sulfanilamide) was synthesized. In 1936, Goissedet, Despois, Gaillot and Mayer<sup>37</sup> synthesized para benzylaminobenzenesulfonamide.

While many compounds related to the prontosils have been investigated, the work of Tréfouel and his coworkers<sup>38</sup> and of Buttle and his associates<sup>39</sup> during 1935 and 1936 indicated that paraaminobenzenesulfonamide, a part of the prontosil molecule, is the pharmacologically effective portion.<sup>4</sup> Sulfanilamide (paraaminobenzenesulfonamide) was stated to be more efficacious than its more complicated predecessors by Colebrook and Kenny<sup>12c</sup> in 1936 and Cooper, Gross and Mellon<sup>40</sup> in 1937. It was also established that sulfanilamide is formed from the prontosils by reduction *in vivo*.<sup>41</sup> Bliss and Long<sup>41a</sup> showed that the amino acid cysteine produced an activation of prontosil soluble sufficient to be demonstrated *in vitro* as well as *in vivo* and that this activation was of a degree which would result were sulfanilamide formed.<sup>4</sup> Finally, Fuller<sup>41b</sup> isolated sulfanilamide from the urine of patients receiving

35 Tréfouel, Tréfouel, Nitti and Bovet<sup>12a</sup> Nitti and Bovet<sup>12c</sup>

36 Fourneau, E., and others (a) *Chimiothérapie des infections streptococciques par les dérivés du p-aminophenylsulfamide*, *Compt rend Soc de biol* **122** 258, 1936, (b) *Action du para-aminophenylsulfamide sur les moisissures*, *ibid* **122** 652, 1936, (c) *Action antistreptococcique des dérivés sulfures organiques*, *Compt rend Acad d sc* **204** 1763 (June 7) 1937

37 Goissedet, P., Despois, R., Gaillot, P., and Mayer, R. *De l'action du radical sulfamide SO<sub>2</sub>NH<sub>2</sub> sur l'infection streptococcique expérimentale de la souris*, *Compt rend Soc de biol* **121** 1082, 1936

38 Tréfouel, Tréfouel, Nitti and Bovet<sup>12a</sup> Nitti and Bovet<sup>12c</sup> Fourneau and others (footnote 36 a and b)

39 (a) Buttle, G. A. H., Gray, W. H., and Stephenson, D. *Protection of Mice Against Streptococcal and Other Infections by p-Aminobenzene-Sulphonamide and Related Substances*, *Lancet* **1** 1286 (June 6) 1936 (b) Buttle, G. A. H., and others. *Treatment of Streptococcal Infections in Mice with 4,4'-Diaminodiphenylsulphone*, *ibid* **1** 1331 (June 5) 1937 (c) Colebrook, L., Buttle, G. A. H., and O'Meara, R. A. Q. *The Mode of Action of p-Aminobenzenesulfonamide and Prontosil in Haemolytic Streptococcal Infections*, *ibid* **2** 1323 (Dec 5) 1936

40 Cooper, F. B., Gross, P., and Mellon, R. R. *Action of p-Aminobenzenesulfonamide on Type III Pneumococcus Infections in Mice*, *Proc Soc Exper Biol & Med* **36** 148 (March) 1937

41 (a) Bliss, E. A., and Long, P. H. *Activation of "Prontosil Solution" *in Vitro* by Reduction with Cysteine Hydrochloride*, *Bull Johns Hopkins Hosp* **60** 149 (Feb) 1937 (b) Fuller, A. T. *Is p-Aminobenzenesulphonamide the Active Agent in Prontosil Therapy?* *Lancet* **1** 194 (Jan 23) 1937 (c) Colebrook, Buttle and O'Meara<sup>39c</sup>

42-44 Footnotes deleted

the original prontosil or prontosil soluble These observations account for the fact that the prontosils have been shown to be essentially inactive *in vitro* <sup>4</sup>

There is some evidence that the sulfonamide grouping is not essential to an action resembling that of sulfanilamide Buttle and his associates <sup>39b</sup> investigated certain compounds related to sulfanilamide which do not contain the sulfonamide grouping The streptococcicidal power of one of these, 4, 4'-diaminodibenzenesulfone, was claimed to be more active than that of sulfanilamide, but the drug is more toxic for mice Another, 4, 4'-dinitrodibenzenesulfone, is less toxic than sulfanilamide but produces undesirable side effects Fourneau, Tréfouël Nitti, Bovet and Trefouel <sup>36c</sup> have shown that 4, 4'-dinitrodibenzenesulfide and 4, 4'-dinitrodibenzenedisulfide have similar properties These drugs are more efficacious when given by mouth than when injected subcutaneously The sulfones produce symptoms which are more persistent than those produced by sulfanilamide

Rosenthal, Bauer and Branham <sup>45</sup> concluded that disulfanilamide (sulfanilylsulfanilamide, paraaminobenzenesulfonylparaaminobenzenesulfonamide) was more effective than sulfanilamide in the treatment of streptococcic infections in mice and exhibited a toxicity one fifth of that of sulfanilamide The maximum action of this drug, however, is obtained only by subcutaneous injection, owing to its low solubility and poor absorption from the gastrointestinal tract

#### MODE OF ACTION

Although the mode of action of the prontosils on the streptococcus was not understood by the first German observers, Domagk <sup>11</sup> reported that phagocytosis of the streptococci by the leukocytes played an important role in clearing the tissues of streptococci in his treated mice He noted also that such azo compounds had no effect on streptococci *in vitro* Although Colebrook and Kenny <sup>12c</sup> found that Girard's sulfonamidochrysoidine and prontosil soluble when administered parenterally to normal human beings and to certain laboratory animals did not give the serum an inhibitory effect on streptococci *in vitro*, they found that the serum from patients ill with streptococcic infection did possess a definite bacteriostatic effect *in vitro* after the patients had been treated with one of these preparations

Long and Bliss <sup>46</sup> were unable to confirm the observations on the serum of patients ill with streptococcic infections and attributed their

45 Rosenthal, S M, Bauer, H, and Branham, S E Studies in Chemotherapy IV Comparative Studies of Sulphonamide Compounds in Experimental Pneumococcus, Streptococcus and Meningococcus Infections, Pub Health Rep 52 662 (May 21) 1937

46 Long, P H, and Bliss, E A (a) Para-Aminobenzenesulfonamide and Its Derivatives Clinical Observations on Their Use in the Treatment of Infections Due to Beta Hemolytic Streptococci, Arch Surg 34 351 (Feb) 1937, (b) footnote 12 f

results to the bactericidal property of the serums, a phenomenon described by Tillett<sup>47</sup> Colebrook, Buttle and O'Meara<sup>39c</sup> demonstrated a bacteriostatic and bactericidal action of paraaminobenzenesulfonamide (sulfanilamide) against small numbers of hemolytic streptococci in culture mediums and in blood. They found the original prontosil and prontosil soluble to be inactive, as previously reported, but were able to demonstrate inhibitory effects when the original prontosil or prontosil soluble was reduced with magnesium powder in a partial vacuum. Other strong reducing agents, namely formaldehyde sulfoxylate<sup>12f</sup> and cysteine hydrochloride,<sup>41a</sup> were found by Long and Bliss to activate the inactive prontosil soluble as far as bacteriostasis was concerned. They<sup>47a</sup> observed also that large numbers of hemolytic streptococci had the power of partially reducing prontosil soluble in vitro. In advancing the hypothesis that in human patients ill with a streptococcic infection, a reduction of the prontosils to an active form is accomplished through an unknown reducing system, they pointed out that this hypothesis was based mainly on in vitro experiments and that the chemicals might prove to exert therapeutic effects in vivo which were not dependent on reduction to an active form. Long and Bliss<sup>12f</sup> suggested that the bacteriostatic action might not be an essential factor in the therapeutic results obtained.

Shortly after Domagk's original report, the Tréfouels, Nitti and Bovet<sup>12a</sup> and later Buttle and his associates obtained indications that sulfanilamide (paraaminobenzenesulfonamide), a part of the prontosil molecule, is the pharmacologically effective portion. Colebrook and Kenny<sup>12e</sup> and Cooper, Gross and Mellon<sup>40</sup> reported sulfanilamide to be more efficacious than its more complicated predecessors. That sulfanilamide is formed from Girard's sulfonamidochrysoidine (supposedly identical with the original prontosil) and from prontosil soluble by reduction in vivo was established by Colebrook and Kenny,<sup>12e</sup> Bliss and Long<sup>41a</sup> and Fuller,<sup>41b</sup> and Bliss and Long demonstrated that the amino acid cysteine produced an activation of prontosil soluble sufficient to be demonstrated in vitro as well as in vivo and comparable to that to be expected were sulfanilamide formed. Finally, Fuller<sup>41b</sup> was able to isolate sulfanilamide from the urine of patients treated with the original prontosil or with prontosil soluble.

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47 Tillett, W. S. The Bactericidal Action of Human Serum on Hemolytic Streptococci. Observations Made with Serum from Patients with Acute Infections and from Normal Individuals, *J. Exper. Med.* **65** 147 and 163 (Jan.) 1937.

47a Long, P. H., and Bliss, E. A. Use of Sulfanilamide or Derivatives in Treatment of Infections Due to Beta Hemolytic Streptococci, *South. M. J.* **30** 479 (May) 1937.

Colebrook and his associates<sup>39c</sup> suggested that the bactericidal action of the tissues of the whole animal might be important in obtaining the effects of the drug, but Long and Bliss<sup>1-f</sup> were inclined to believe that the phagocytic activity of the polymorphonuclear leukocytes and monocytes played a paramount role in controlling infections caused by beta hemolytic streptococci. Gross, Cooper and Peebles,<sup>48</sup> by experiments with mice, were unable to demonstrate a greater indication of phagocytosis in treated animals than in the untreated controls. Weinberg Mellon and Shinn<sup>49</sup> found no indications of increased phagocytosis in animals treated with sulfanilamide.

Levaditi and Vaisman<sup>1-b</sup> had early suggested that the drug acted by preventing the formation of capsules. Various authors theorized on the possible role of the reticuloendothelial system, which might combat streptococcal infections when stimulated by the sulfonamide compounds. Bosse<sup>50</sup> claimed to have demonstrated a considerable weakening of the protective action of prontosil (preparation not specified) against hemolytic streptococcal infections in splenectomized mice but gave no details regarding the number of mice employed or the manner in which the experiment was controlled. A possible role of the reticuloendothelial system appears to have been eliminated by the finding of Gross, Cooper and Peebles<sup>48</sup> that sulfanilamide is capable of protecting splenectomized mice against fatal doses of highly virulent hemolytic streptococci and that the degree of protection observed in splenectomized mice was identical with that obtained with normal animals.

Levaditi and Vaisman<sup>20b</sup> demonstrated the neutralizing effect of sulfanilamide and various derivatives on the leukocidins and hemolysins of streptococci in vitro. Rosenthal,<sup>51</sup> in reporting that sulfanilamide was bactericidal for pneumococci, emphasized that the drug is more effective against streptococci than against pneumococci in animals but is not inhibitory to the growth of streptococci in the test tube. The bacteriostatic and bactericidal action of sulfanilamide on pneumococci in vitro was regarded by Rosenthal as adequate explanation for its chemotherapeutic effect in animals. The nature of this action in vitro is unusual since the drug is not an antiseptic in the usual sense.

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48 Gross, P., Cooper, F. B., and Peebles, M. L. Effect of Splenectomy on the Therapeutic Action of *p*-Aminobenzenesulfonamide on Mice Infected with Hemolytic Streptococcus, *Proc Soc Exper Biol & Med* **36** 311 (April) 1937.

49 Weinberg, M. H., Mellon, R. R., and Shinn, L. E. Two Cases of Streptococcal Meningitis Treated Successfully with Sulfanilamide and Prontosil, *J A M A* **108** 1948 (June 5) 1937.

50 Bosse, O. A. Die Therapie der Streptokokkenkrankungen mit "Prontosil," *Fortschr d Therap* **12** 540 (Sept.) 1936.

51 Rosenthal, S. M. Studies in Chemotherapy. III. The Effect of *p*-Aminobenzene Sulphonamide on Pneumococci in Vitro, *Pub Health Rep* **52** 192 (Feb 12) 1937.

Hawking<sup>52</sup> reported that 1 1,000 solutions of sulfanilamide had no effect on the intestine of the rabbit or uterus of the guinea pig suspended *in vitro* at 37 C or on the heart of the frog perfused through the inferior vena cava. No effect on the blood pressure in the cat or dog occurred when 0.17 Gm of the drug per kilogram of body weight was given. Intraperitoneal injections of large doses in animals caused no local irritation. Large doses of 1.5 to 2 Gm per kilogram of body weight, occasionally produced death in rabbits and cats. Weakness of the legs, dyspnea, panting, general appearance of decerebrate rigidity and the like were commonly noted. The surviving animals were killed after a week, but the liver, kidneys and viscera showed no changes histologically. In 3 animals dying of the effects of drug degenerative changes (chromatolysis) were observed in the neurons of the anterior column of the spinal cord and in some of the neural cells of the cortex and midbrain.

Gay and Clark<sup>53</sup> found that the serum, defibrinated blood and artificial pleural exudate of rabbits treated with sulfanilamide inhibit the growth of streptococci *in vitro* but that repeated doses of such treated serum fail to sterilize the culture. The coccic chains grown in serum so treated are elongated and present pleomorphic and metachromatic organisms and may give rise to colonies that are at first less predominantly mucoid in appearance. Such organisms have lost little if any of their virulence. Cooperation on the part of locally derived clasmato-cytes is apparently required for complete sterilization of the animal body. Sulfanilamide produces bacteriostasis sufficiently marked to protect the accumulated leukocytes and to allow the natural accumulation of defensive macrophages. There is no direct evidence that the drug does not in itself stimulate the mobilization of the macrophages according to Gay and Clark and they feel there is no evidence that the reaction in the cells which finally accounts for the disposal of the organisms is other than local.

Bliss and Long<sup>54</sup> attempted to determine whether or not the presence of polymorphonuclear leukocytes is a necessary adjunct to sulfanilamide therapy. Mice were rendered granulocytopenic by the administration of benzene. As controls for each granulocytopenic mouse infected with virulent hemolytic streptococci and treated with sulfanilamide similarly infected mice were employed consisting of a normal mouse, an untreated

52 Hawking, F. Pharmacological Actions of Sulphanilamide, *Lancet* 2:1019 (Oct. 30) 1937.

53 Gay, F. P. and Clark, A. R. On the Mode of Action of Sulfanilamide in Experimental Streptococcus Empyema, *J. Exper. Med.* 66:535 (Nov.) 1937.

54 Bliss, E. A., and Long, P. H. Observations on the Mode of Action of Sulfanilamide, *J. A. M. A.* 109:1524 (Nov. 6) 1937.



granulocytopenic mouse, a mouse treated with benzene and sulfanilamide, a mouse treated with benzene, and a mouse treated with sulfanilamide. The untreated control mice died within thirty-six hours, the untreated granulocytopenic mice within twenty-four hours, the mice treated with benzene within thirty-six hours and the granulocytopenic mice treated with sulfanilamide within seventy-two hours, while the mice treated with sulfanilamide and those treated with benzene and sulfanilamide survived. The experiment seems to prove that polymorphonuclear leukocytes are necessary in the process that leads to control of infection in mice treated with sulfanilamide.

Further experiments with experimental streptococcic infections in mice led Bliss and Long<sup>54</sup> to believe that the action of sulfanilamide is primarily one of slowing down the rate of multiplication of the streptococci and thus permitting the phagocytes to dispose of them before they exert a lethal effect on the mouse. They failed to demonstrate alteration in the hemolytic streptococci isolated from the peritoneal exudates of treated infected mice in so far as type of colonial formation, virulence for mice or presence of capsular material were concerned, in these respects the streptococci were identical with those isolated from untreated control mice. Bliss and Long also observed that when peritonitis is experimentally induced in mice by infection with Welch's bacillus death quickly occurs in untreated mice from overwhelming toxemia. The organism itself is not resistant to phagocytosis, and from the beginning of infection the phagocytes are filled with ingested bacteria. When a lethal dose is injected, however, the leukocytes, although extraordinarily active in phagocytosis, cannot ingest enough bacteria to keep pace with the multiplication of, and formation of toxin by, the organism, and the mouse succumbs in a short time. Up to the time of death there is no evidence that phagocytosis is either absolutely or relatively decreased in the untreated mice. This sequence of events was definitely altered when treatment with sulfanilamide was instituted. From the very beginning of treatment, there was a decrease in the number of free bacilli in the peritoneal exudate. Phagocytosis was marked, but the total number of ingested bacteria in the case of the treated mice was less than in the case of the control mice. Successive observations showed a progressive decrease in the number of free and ingested bacteria in the peritoneal exudates. Bliss and Long expressed the opinion that, since the only essential difference between the untreated and the treated mice was in the number of bacteria free in the exudates at the various periods of observation, the only interpretation of the facts was that sulfanilamide inhibited the growth of the bacteria *in vivo*. They concluded from their experiments with streptococcic peritonitis in mice that the action of sulfanilamide was that of bacteriostasis rather

than that of a direct protective or stimulative action on the phagocytes, it appeared that in this type of infection the effect of the sulfanilamide therapy is to reduce the rate of multiplication of the streptococci to a point at which they no longer produce enough leukocidin and other toxic products to inhibit rapid phagocytosis. This effect permits the exudates and tissues to be freed of organisms by the leukocytes, and recovery from infection follows.

Turning to marrow cultures for the study of the effects of sulfanilamide on living human marrow cells, Osgood and Brownlee<sup>55</sup> were able to throw further light on the mechanism involved in the control of infection with hemolytic streptococci by this drug. Cultures of living human marrow cells containing sulfanilamide in concentrations of 1:250 to 1:500,000 did not differ from control cultures without sulfanilamide for the first forty-eight hours in cell count, number of mitotic figures, structure of cells, differential count, appearance with supravital stains or ability to phagocytose bacteria. On exposure for a period of eight days or less, concentrations of sulfanilamide of less than 1:1,000 did not grossly affect the growth of the marrow cells. Marrow cultures infected with hemolytic streptococci and containing sulfanilamide in concentrations of 1:100,000 or more were sterile in subculture and contained no visible streptococci in stained smears after twenty-four hours, infected controls showed gross hemolysis and complete destruction of all leukocytes and erythrocytes. Osgood and Brownlee noted no variation in the effectiveness of concentrations of sulfanilamide from 1:1,000 to 1:100,000, even a concentration of 1:6,000,000 showed an appreciable bacteriostatic action.

Cultures of hemolytic streptococci in Hartley's broth appeared grossly sterile after twenty-four hours in the presence of sulfanilamide in concentrations of 1:1,000 to 1:100,000, but all the tubes became turbid in from forty-eight to seventy-two hours. Osgood and Brownlee felt that this indicated a definite effect of sulfanilamide on the growth of beta hemolytic streptococci in the absence of human serum or marrow cells but emphasized the fact that the cultures did not become sterile. They demonstrated that the failure of sulfanilamide to kill streptococci in all instances was not due to the development of a resistant strain and that destruction of sulfanilamide does not explain the survival of large inoculations of streptococci. Osgood and Brownlee<sup>55</sup> stated that the major action of sulfanilamide on infections with beta hemolytic streptococci is the neutralization or destruction of toxins and the decrease in the rate of division of the organisms and concluded that the bacteriocidal

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<sup>55</sup> Osgood, E. E., and Brownlee, I. E. Culture of Human Marrow. Studies on the Mode of Action of Sulfanilamide, *J. A. M. A.* **110** 349 (Jan. 29) 1938.

action of human serum and the phagocytic action of the neutrophils and monocytes of the marrow and blood overcome the infection not because sulfanilamide kills the streptococci but because it neutralizes the toxins and decreases the rate of multiplication

In the light of these experiments it appears that sulfanilamide in concentrations of 1 100,000 may be effective, and this may explain the fact that a number of compounds <sup>56</sup> which are not in themselves bacteriostatic but which break down in the body to yield sulfanilamide become effective in doses insufficient to form sulfanilamide in concentrations of 1 10,000 in the blood Colebrook, Buttle and O'Meara <sup>59c</sup> had observed a discrepancy between the failure to kill streptococci with a 1 100 solution of sulfanilamide in broth and the killing of streptococci with much lower concentrations in blood, attributing this to a bactericidal or bacteriostatic action of sulfanilamide They noted that in monkeys twenty-four hours after administration of sulfanilamide the blood was still capable of overcoming an infection with an inoculation of 6,000 streptococci per cubic centimeter The concentration of sulfanilamide in the blood at this time, as shown by Marshall, Emerson and Cutting's data on excretion,<sup>57</sup> was probably much less than 1 10,000

Of practical clinical importance are the following conclusions of Osgood and Brownlee <sup>55</sup> The continuous presence of a low concentration of sulfanilamide is more effective than the intermittent presence of a high concentration The smaller the number of organisms, the greater is the effectiveness of the drug, and therefore therapy should be instituted at the earliest possible moment Small doses at frequent intervals to maintain the concentration of the drug in the body fluids above 1 100,000 at all times are more effective than large doses at longer intervals Therapy should not be discontinued until cultures are negative, if viable organisms remain, recrudescence is almost inevitable, and the administration of the drug must be resumed

Hemmens and Dack,<sup>58</sup> however, stated that the results of Osgood and Brownlee, Colebrook, Buttle and O'Meara and Long and Bliss

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56 (a) Gley, P, and Girard, A Un nouveau derive de la sulfamido-chrysoïdine tres actif contre l'infection streptococcique, Presse méd 44 1775 (Nov 11) 1936 (b) Trefouel, J, Trefouel, J (Mme), Nitti, F, and Bovet, D Chimiotherapie des infections streptococciques par les derives du p-amino-phenylsulfamide, Ann Inst Pasteur 58 30 (Jan) 1937 (c) Bovet, D Recherches experimentales dans le domaine de la chimiotherapie des infections bacteriennes, Schweiz med Wchnschr 67 288 (April 3) 1937 (d) Levaditi and Vaisman <sup>29c</sup> (e) Fourneau and others <sup>36c</sup>

• 57 Marshall, E K, Jr, Emerson, K, Jr, and Cutting, W C Para-Amino-benzenesulfonamide Absorption and Excretion, Method of Determination in Urine and Blood, J A M A 108 953 (March 20) 1937

58 Hemmens, E S, and Dack, G M Mode of Action of Sulfanilamide, J A M A 110 1209 (April 9) 1938

could be adequately explained by an inhibitory action of the drug on the reproductive rate of the organism and that it seems unnecessary to postulate any direct effect of the drug on the toxins of beta hemolytic streptococci in order to explain this action, especially since a bacteriostatic action of the drug was not excluded by their experiments. Slowing of the metabolism of the organisms, reflected by a slower rate of reproduction, also might account for diminished production of toxic substances, and Hemmens and Dack noted that such an action would explain their observation of some decrease in the size of hemolyzed areas about colonies produced by organisms which had been exposed to sulfanilamide. They also found that a non-toxin-producing organism, *Bacillus necrophorus*, invariably produced fatal disease in rabbits when a virulent bovine strain was used. The infection, however, could be controlled and cured by treating the infected animals with sulfanilamide. If this observation is substantiated, it would negate the thesis that the elaboration of an exotoxin by an organism is necessary to the action of sulfanilamide against that organism.

Finklestone-Sayliss, Paine and Patrick<sup>59</sup> concluded that sulfanilamide does not modify the activities of the polymorphonuclear leukocytes but found that the drug stimulated the phagocytic activity of the reticuloendothelial cells of rabbits. The effect of sulfanilamide on the leukocytes has received much attention.<sup>60</sup> Bigler, Clifton and Werner<sup>61</sup> administered the drug by mouth on the basis of 15 grains (1 Gm) to 20 pounds (9 Kg) of body weight, irrespective of age. In patients with leukocytosis, the white cell count tended to drop within twenty-four to thirty-six hours after clinical improvement was noted, although occasionally the drop occurred forty-eight or more hours after clinical improvement. In some instances, the leukocytosis was unchanged, and in long drawn out infections the leukocyte count could not be lowered. In no instance did the authors note during the administration of sulfanilamide an increase in the white cell count which was not attributable to the infection. Leukopenia was likely to occur in patients with a normal leukocyte count when sulfanilamide was administered. That the drug caused a depression of leukocytes was evidenced by the production of leukopenia and the rapid fall of leukocytes at the end of an infection, often followed by a moderate increase in leukocytes after the drug was

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59 Finklestone-Sayliss, H, Paine, C G, and Patrick, L B. Bacteriostatic Action of *p*-Aminobenzenesulfonamide upon Hemolytic Streptococci, *Lancet* **2** 792 (Oct 2) 1937

60 Sulfanilamide and the Leukocytes, editorial, *J A M A* **110** 372 (Jan 29) 1938

61 Bigler, J A, Clifton, W M, and Werner, M. The Leukocyte Response to Sulfanilamide Therapy, *J A M A* **110** 343 (Jan 29) 1938

discontinued. The alteration in leukocyte response<sup>61</sup> appears to be a marked absolute reduction of all the cell elements without characteristic relative change, the granulocytes are not reduced out of proportion to the other cells. The Schilling differential count merely reflects what may be considered a healing infection<sup>61</sup>. Bigler, Clifton and Werner<sup>61</sup> noted little effect on either red blood cells or platelets and could find little if any fall in the hemoglobin content of the blood.

Hawking<sup>52</sup> found that sulfanilamide has almost no action on the smooth muscles, the heart or the blood pressure. When large doses were given to rabbits or cats, it produced nervous symptoms somewhat resembling decerebral rigidity. In normal animals<sup>41b</sup> 35 per cent of ingested sulfanilamide and 49 per cent of prontosil soluble were not accounted for. In infected animals 54 per cent of the ingested sulfanilamide and 61 per cent of prontosil soluble were not accounted for. This may be due to retention by the inflamed tissues or to impairment of kidney function. Czarnetzky and Sevag<sup>62</sup> have recently pointed out the possibility that inorganic sulfites might be substituted for sulfanilamide in the chemotherapy of streptococcal infection.

As shown by Marshall, Emerson and Cutting,<sup>57</sup> sulfanilamide is approximately equally distributed in the tissues of the organism (with the exception of bone and fat) and is probably present in equal concentration in all parts of the body if the concentrations are expressed per unit of water. Earlier observers had become convinced that sulfanilamide when administered by mouth was almost completely absorbed from the gastrointestinal tract in about four hours. The drug appears to pass readily from the blood stream and to become widely distributed throughout the tissues, in which the concentration is only slightly lower than in the blood. Simultaneous determinations of sulfanilamide in the blood and in the spinal fluid of man<sup>63</sup> during several hours of administration of the drug indicated that the concentration in the spinal fluid is parallel to and only slightly lower than that in the blood. The presence of the drug has been demonstrated in the saliva, the urine, the pancreatic juice, the bile, the cerebrospinal fluid, the blood plasma and the nasal and the lacrimal secretion.

While Temming<sup>64</sup> first used the original prontosil in the treatment of urinary infections, its successful use in the urinary infections of

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62 Czarnetzky, E. J., and Sevag, M. G. The Action of Sodium Bisulphite and Sulfanilamide on Purine and Pyrimidine Compounds with the Production of Hemolysins, and a Suggested Mechanism of the Action of Sulfanilamide on Hemolytic Streptococci, *Am J M Sc* **195** 426 (March) 1938.

63 Marshall, E. K., Jr., Emerson, K., Jr., and Cutting, W. C. The Distribution of Sulfanilamide in the Organism, *J Pharmacol & Exper Therap* **61** 191 (Oct) 1937.

64 Temming, C. E., cited by Maraun<sup>65d</sup>

childhood was soon reported by numerous other clinicians <sup>65</sup> The effectiveness of sulfanilamide in the treatment of urinary infections demonstrated by other investigators <sup>66</sup> stimulated a study of the renal excretion of the drug Marshall, Emerson and Cutting <sup>67</sup> and Fuller <sup>41b</sup> demonstrated that sulfanilamide is partially converted in man and in the rabbit into a conjugated form Thus, the drug is practically entirely excreted in the urine in a free state and in the conjugated form as paraacetylaminobenzenesulfonamide Harris and Klein <sup>67</sup> in experiments with tissue (liver, muscle, spleen, kidney and blood) concluded that only the liver could convert sulfanilamide into the conjugated form Marshall, Emerson and Cutting <sup>68</sup> demonstrated that the clearance of sulfanilamide in the urine is independent of the plasma level and is increased by an increase in the rate of flow of the urine Helmholz, and Osterberg <sup>66a</sup> found that sulfanilamide given by mouth produces a urine strongly bactericidal for organisms usually found in infections of the urinary tract with the exception of *Streptococcus faecalis* They found the same concentration of the drug more bactericidal in alkaline than in acid urine and later reported <sup>68</sup> that sulfanilamide in its free form when added in concentrations of only 25 to 40 mg of sulfanilamide per hundred

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65 (a) Unshelm, E Zur Behandlung der kindlichen Pyurie, Arch f Kinderh **109** 65, 1936 (b) Helmholz, H F Use of Sulfanilamide as Urinary Antiseptic, J Pediat **11** 243 (Aug) 1937 (c) Klein, E Prontosil in der Kinderpraxis, Med Klin **33** 940 (July 10) 1937 (d) Maraun, L Zur Prontosilbehandlung des Erysipels und der Pyurie, Kinderarztl Praxis **7** 445 (Oct) 1936 (e) Pernice, W Ueber der Behandlung der kindlichen Pyurie mit Prontosil, ibid **7** 304 (July) 1936

66 (a) Cook, E N, and Buchtel, H A The Use of Sulfanilamide (Prontylin) in Urinary Infections, Proc Staff Meet, Mayo Clin **12** 381 (June 16) 1937 (b) Buchtel, H A, and Cook, E N The Use of Sulfanilamide (Prontylin) in Urinary Infections, ibid **12** 433 (July 14) 1937 (c) Helmholz, H F Comparison of Mandelic Acid and Sulfanilamide as Urinary Antiseptics, J A M A **109** 1039 (Sept 25) 1937 (d) Helmholz, H F, and Osterberg, A E Rate of Excretion and Bactericidal Power of Sulfanilamide in Urine, Proc Staff Meet, Mayo Clin **12** 377 (June 16) 1937 (e) Barer, M Typhoid Bacilluria Treated with Sulphanilamide, Lancet **2** 964 (Oct 23) 1937 (f) Helmholz, H F Bactericidal Power of the Urine After the Administration of Prontylin by Mouth, Proc Staff Meet, Mayo Clin **12** 244 (April 21) 1937 (g) Dees, J E, and Colston, J A C The Use of Sulfanilamide in Gonococcal Infections, J A M A **108** 1855 (May 29) 1937 (h) Walther, H W E Urinary Antisepsis, Historical Review and Present Evaluation, ibid **109** 999 (Sept 25) 1937 (i) Hoerlein, H Development of Chemotherapy for Bacterial Diseases, Practitioner **139** 635 (Dec) 1937

67 Harris, J S, and Klein, J R Acetylation of Sulfanilamide by Liver Tissue in Vitro, Proc Soc Exper Biol & Med **38** 78 (Feb) 1938

68 Helmholz, H F, and Osterberg, A E The Effect of  $pH$  of the Urine on Concentration of Free and Conjugated Sulfanilamide Necessary for Bactericidal Action, Proc Staff Meet, Mayo Clin **12** 661 (Oct 20) 1937

cubic centimeters to an alkaline urine acts bactericidally. Concentrations as low as 25 to 30 mg per hundred cubic centimeters when excreted in alkaline urine act bactericidally.

The determination of sulfanilamide in biologic mediums was stimulated by the detection of the drug in the urine and the blood. Marshall and his coworkers,<sup>69</sup> Kellner<sup>70</sup> and Scudi<sup>71</sup> contributed to the advance in the technic of identifying the drug in tissues and secretions. Marshall and Babbitt<sup>72</sup> reported a method for the determination of sulfanilamide in blood and urine based on the diazotization of the para-aminobenzenesulfonamide with nitrous acid and the coupling of the resulting diazo compound in acid solution with dimethyl- $\alpha$ -naphthylamine to produce a purplish red azo dye which can be easily estimated by colorimetric comparison.

#### EFFECT ON EXPERIMENTAL INFECTIONS IN ANIMALS

Although Domagk<sup>11</sup> demonstrated in 1935 that the original prontosil in doses one tenth to one fiftieth of the tolerated amount, given over a period of three to five days, protected mice against ten times the lethal dose of hemolytic streptococci, the Tréfouels, Nitti and Bovet<sup>12a</sup> were the first to show the activity of sulfanilamide in streptococcic infections of mice. Mice inoculated intraperitoneally with a strain of hemolytic streptococcus isolated in a case of fatal septicemia were treated with the hydrochloride of paraaminobenzenesulfonamide by mouth for two days, the treated mice survived in some instances for more than ten days, while the control mice died in less than forty-eight hours. Rabbits inoculated with a virulent strain of hemolytic streptococcus when given the drug by mouth survived from two days to one week longer than the controls. Goissedet and his coworkers<sup>37</sup> confirmed the finding that the antistreptococcic power may exist in a molecule possessing the sulfonamide and amino radicals but not the azo group.

It was soon noted that prolonged survival of all the animals treated was rare regardless of the manner in which the drug was administered.<sup>73</sup>

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69 Marshall, E K, Jr. Determination of Sulfanilamide in Blood and Urine, *Proc Soc Exper Biol & Med* **36** 422 (April) 1937. Marshall, E K, Jr, Cutting, W C, and Emerson, K, Jr. Acetylation of Para-Amino-Benzene-Sulfonamide in the Animal Organism, *Science* **85** 202 (Feb 19) 1937. Footnotes 57 and 63.

70 Kellner, K. Etude sur l'elimination de la sulfamido-chrysoïdine, Thesis, Paris, no 652, 1936.

71 Scudi, J V. Determination of Sulfanilamide in Biologic Mediums, *J Biol Chem* **122** 539 (Jan) 1938.

72 Marshall, E K, Jr, and Babbitt, D. Determination of Sulfanilamide in Blood and Urine, *J Biol Chem* **122** 263 (Dec) 1937.

73 Holman, W L, and Duff, G L. Sulfanilamide and Similar Compounds in Chemotherapy, *Am J M Sc* **195** 379 (March) 1938.

Living cocci were frequently obtained from the blood or tissues of treated mice long after the untreated controls had died <sup>73</sup> Furthermore, animals dying after long periods of streptococcic infection frequently failed to show the pathologic lesions characteristic of death from streptococci These observations were contrary to the conception of a germicidal or antiseptic action on the part of the drug Buttle and his associates <sup>39</sup> and Proom <sup>74</sup> confirmed the work of the Tréfouels and further showed that the treatment with sulfanilamide of mice infected with hemolytic streptococci and meningococci was more effective than that with the original prontosil <sup>75</sup> Standardization of experimental procedures with sulfanilamide in animals was advanced by Buttle <sup>39a</sup> and Whitby <sup>76</sup>

Colebrook and Kenny <sup>77</sup> in observing the therapeutic effect of sulfanilamide on streptococcic septicemia of mice found that with a single exception all the controls died after forty-eight hours, while the treated animals survived for more than thirty days and only 1 died on the thirty-second day The surviving treated mice were killed on the thirty-fourth and the thirty-fifth day, and the cultures of the blood were found sterile While intraperitoneal injections of hemolytic streptococci have been employed in most of the experimental work, other sites of injection have been employed Berger and Schnetz <sup>78</sup> produced streptococcic abscesses in mice by subcutaneous injection of the organisms Administration of prontosil soluble by mouth five hours later with the dose repeated up to five days prevented the general spread of infection and the establishment of fatal metastases in a majority of mice Long and Bliss <sup>12f</sup> observed a marked reduction in the growth of hemolytic streptococci when various concentrations of sulfanilamide were used in broth culture as well as in the presence of 50 per cent normal horse serum broth They <sup>46a</sup> noted that some mice, however, died thirty-nine days and even sixty-three to one hundred and twenty-eight days after treatment was discontinued, although apparently in good health during the interval Levaditi and Vaisman <sup>12b</sup> reported mice dying of hemolytic streptococcic infection eighteen to nineteen days after apparent cure

74 Proom, H Therapeutic Action of *p*-Aminobenzenesulphonamide in Meningococcal Infection of Mice, *Lancet* **1** 16 (Jan 2) 1937

75 Buttle, G A H Chemotherapy in Streptococcic Infections, *J A M A* **108** 747 (Feb 27) 1937

76 Whitby, L E H (a) Assessment of Efficiency of Chemotherapeutic Substances, *Practitioner* **139** 650 (Dec) 1937, (b) An Experimental Assessment of the Therapeutic Efficacy of Amino Compounds with Special Reference to *p*-Benzylaminobenzenesulfonamide, *Lancet* **1** 1517 (June 26) 1937

77 Colebrook, L, and Kenny, M (a) Treatment with Prontosil of Puerperal Infections Due to Hemolytic Streptococci, *Lancet* **2** 1319 (Dec 5) 1936, (b) footnote 12 c

78 Berger, W, and Schnetz, H Ein Behandlungserfolg bei Morbus Bang mit Prontosil, *Med Klin* **33** 594 (April 30) 1937



Raiziss, Severac and Moetsch <sup>79</sup> investigated the toxicity of sulfanilamide by using the drug subcutaneously in mice, intravenously in rats and rabbits and orally in rabbits. The maximum tolerated dose (administered subcutaneously) for mice was found to lie between 2 and 2.5 Gm per kilogram of body weight. The maximum tolerated dose (administered intravenously) for rabbits and rats could not be determined because of the limited solubility of sulfanilamide, but rats tolerated 0.4 Gm per kilogram of body weight and rabbits 0.2 Gm. Oral administration of sulfanilamide in doses of 2 Gm per kilogram of body weight was fatal in 50 per cent of rabbits, 2.5 Gm was lethal, but 1.5 Gm was tolerated by 94 per cent of rabbits. The investigators concluded that one-fourth the maximum tolerated dose is necessary to produce a curative effect in mice infected with a very virulent strain of beta hemolytic streptococci. Rosenthal <sup>79a</sup> found that no symptoms were produced when sulfanilamide was administered to mice in doses of 1 Gm per kilogram of body weight twice a day for two days, followed by 0.5 Gm per kilogram twice a day for three days. A 50 per cent increase of the dose over similar periods produced loss of weight but no deaths. A mortality of 50 per cent occurred when an increase to 2 Gm per kilogram was employed in the first period and to 1 Gm per kilogram in the second period.

The work of Gay and Clark <sup>53</sup> has been previously described as demonstrating the effectiveness of sulfanilamide in experimental empyema in the rabbit. Kolmer, Brown and Raiziss <sup>80</sup> reported the therapeutic effect of sulfanilamide in experimental infections of the skin and the joints in rabbits. Numerous workers <sup>81</sup> became concerned with

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79 Raiziss, G. W., Severac, M., and Moetsch, J. C. Chemotherapeutic Studies of Sulfamidyl (Para-Amino-Benzene-Sulfonamide) in Experimental Beta-Hemolytic Streptococcal Infection, *J. Chemotherapy* **14** 1 (April) 1937.

79a Rosenthal, S. M. Studies in Chemotherapy. II. Chemotherapy of Experimental Pneumococcus Infections, *Pub. Health Rep.* **52** 48 (Jan. 8) 1937.

80 Kolmer, J. A., Brown, H., and Raiziss, G. W. Chemotherapy of Experimental Streptococcus Infections of Rabbits with Special Reference to Pyridine Compounds and Prontosil Soluble, *J. Pharmacol. & Exper. Therap.* **61** 253 (Nov.) 1937.

81 (a) Schwentker, F. F., and others. Use of Para-Amino-Benzene-Sulphonamide or Its Derivatives in Treatment of Beta Hemolytic Streptococcal Meningitis, *Bull. Johns Hopkins Hosp.* **60** 297 (April) 1937. (b) Girard, A., Ray, A., and Richard, G. Antimicrobial Action of Some Aromatic Compounds, *Nature, London* **140** 283 (Aug. 14) 1937. (c) Nitti, F., and Bovet, D. La chimiotherapie des infections microbiennes et les nouveaux essais de traitement et de prevention des streptococcies, *Rev. d'immunol.* **2** 450, 1936. (d) Les septicemies streptococciques experimentales et leur traitement par le *p*-amino-phenylsulfamide, *Compt. rend. Acad. d. sc.* **202** 1221, 1936. (e) Gray, W. H., Buttle, G. A. H., and Stephenson, D. Derivatives of *p*-Aminobenzenesulfonamide in the Treatment of Streptococcal Infection in Mice, *Biochem. J.* **31** 724 (May) 1937. (f) Chemo-

investigations of streptococcic infections in animals and the response to sulfanilamide therapy. While the beta hemolytic streptococcus was found particularly susceptible to the sulfanilamide group of compounds, the streptococci of the Lancefield group A were thought to be almost exclusively susceptible. Long and Bliss<sup>82</sup> found that the Lancefield groups A and B were susceptible to sulfanilamide but noted that the drug was ineffective against the Lancefield group D beta hemolytic streptococci. Seastone<sup>83</sup> found that guinea pigs inoculated with Lancefield's group C hemolytic streptococci were protected by adequate doses of sulfanilamide.

Finklestone-Sayliss, Paine and Patrick<sup>84</sup> found that the bacteriostatic action of sulfanilamide on hemolytic streptococci is preceded by a phase of stimulation of growth. This stimulation is more conspicuous in young cultures than in cultures that have passed through the logarithmic phase of growth. They found also that sulfanilamide is more soluble in the fatty envelop which can be separated from hemolytic streptococci than in aqueous solution. Sulfanilamide has consistently failed to be effective against alpha hemolytic streptococci (*Streptococcus viridans*). Welch<sup>85</sup> considers this noteworthy since it has been established that neoarsphenamine which has a demonstrable action on certain streptococci in blood, is also without effect on *Str. viridans*.

While clinical use of sulfanilamide in staphylococcic infections has had disappointing results, Domagk<sup>81</sup> obtained favorable results in acute spreading infections in rabbits, and the first mention of the sulfanilamide group of drugs in medical literature was that of Foerster,<sup>13</sup> who reported that prontosil soluble (streptozon) had shown a marked chemotherapeutic effect on a boy suffering from a generalized staphylococcic infection. Helmholtz<sup>86c</sup> showed that sulfanilamide in concentrations easily obtainable by oral administration rendered the urine bactericidal for *Staphylococcus aureus*.

The effect of sulfanilamide on pneumococcic infections has received much attention, but in general the experimental results in animals have been better than the results of the clinical application of the drug in

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therapy in Streptococcic Infections, editorial, J. A. M. A. **108** 48 (Jan 2) 1937  
 (g) Peters, B. A., and Havard, R. V. Chemotherapy of Streptococcal Infections with *p*-Benzylamino-Benzene-Sulfonamide, *Lancet* **1** 1273 (May 29) 1937  
 (h) De, S. P., and Basu, U. P. Action of *p*-Amino Benzene Sulphonamide Against Streptococcic Infections in Mice, *Indian J. M. Research* **25** 465 (Oct) 1937  
 (i) Buttle and others<sup>89b</sup>

82 Bliss, E. A., and Long, P. H. Failure of Para-Aminobenzenesulfonamide Therapy in Urinary Tract Infections Due to Group D (Lancefield) Beta Hemolytic Streptococci, *New England J. Med.* **217**.1 (July 1) 1937

83 Seastone, C. V. Effect of Sulfanilamide on Group C Hemolytic Streptococcic Infections, *J. Immunol.* **33** 403 (Nov) 1937

man Domagk<sup>84</sup> had reported the partial effectiveness of the original prontosil and prontosil soluble on the type III pneumococcus but regarded the drugs as of little value in treating infection caused by type I and type II pneumococci. He later<sup>85</sup> found sulfanilamide more effective in pneumococcal infections than the original prontosil, and this opinion was supported by Colebrook and Kenny<sup>77a</sup> and Cooper, Gross and Mellon.<sup>40</sup> Horlein,<sup>85a</sup> in reviewing Domagk's work, asserted that the compound was effective against infections with type III pneumococci but failed to publish in detail his experimental results leading to this conclusion. Rosenthal<sup>86</sup> showed that sulfanilamide used therapeutically prolonged the lives of mice infected with ten to one hundred times the minimum lethal dose of types I, II and III pneumococci. Cooper, Gross and Mellon,<sup>40</sup> independently, made a similar finding concerning infections with type III pneumococci but noted that the drug was not as effective in its action as in the case of streptococcal and meningococcal infections. They felt that their experiments, however, justified the use of the drug in treating human beings infected with type III pneumococci. Nitti, Bovet and Depierre<sup>87</sup> found a direct inhibitory action of sulfanilamide on pneumococci in vitro. Buttle, Parish, McLeod and Stephenson<sup>88</sup> were unable to demonstrate any significant protective action on mice infected with pneumococci of types I and II, whereas Rosenthal<sup>79a</sup> obtained protection for experimental animals against all three fixed types.

Gross and Cooper<sup>90</sup> recalled the lack of parallelism between pneumococcal septicemia in mice and pneumonia in man, and this led to the choice of experimental pneumococcal pneumonia in rats as a closer approximation to human pneumonia. Rats were infected intra-

84 Domagk, G. *Chemotherapie der bakteriellen Infektionen*, *Jahrb d angew Chem* **48** 657, 1935, *Chemotherapie die Streptokokken-Infektionen*, *Klin Wchnschr* **15** 1585 (Oct 31) 1936, footnote 11.

85 Domagk, G. *Weitere Untersuchungen über die chemotherapeutische Wirkung sulfonamidhaltiger Verbindung bei bakteriellen Infektionen*, *Klin Wchnschr* **16** 1412 (Oct 9) 1937.

85a Horlein, H. *Chemotherapy of Infectious Diseases Caused by Protozoa and Bacteria*, *Proc Roy Soc Med* **29** 313 (Feb) 1936.

86 (a) Rosenthal, S. M. *Chemotherapy of Certain Infections with Sulfanilamide and Related Compounds*, *M Ann District of Columbia* **6** 337 (Dec) 1937. (b) Rosenthal, Bauer and Branham<sup>45</sup>.

87 Nitti, F., Bovet, D., and Depierre, F. *Action des derives du p-aminophenylsulfamide (1162 F) sur les streptocoques hémolytiques in vitro*, *Compt rend Soc de biol* **124** 16, 1937.

88 Buttle, G. A. H., Parish, H. J., McLeod, M., and Stephenson, D. *The Chemotherapy of Typhoid and Some Other Non-Streptococcal Infections in Mice*, *Lancet* **1** 681 (March 20) 1937.

89 Footnote deleted.

90 Gross, P., and Cooper, F. B. *p-Aminobenzenesulfonamide and Antipneumococcal Serum Therapy in Type I Pneumococcal Infections of Rats*, *Proc Soc Exper Biol & Med* **36** 535 (May) 1937.

bronchially with type I (Neufeld) pneumococci. The mortality was reduced from 93 per cent in the control group to 21 per cent in the groups treated with serum or sulfanilamide and to 14 per cent in the group treated with both serum and the drug. Since the best therapeutic results were obtained by using a combination of serum and drug, Cooper and Gross<sup>91</sup> assumed that the two methods of treatment were synergistic. They found sulfanilamide was at least as effective as specific antiserum in the treatment of pneumonia caused by infection with type II pneumococci. The combination of sulfanilamide and serum was no more effective than sulfanilamide alone. Contrary to the observations in rabbits (Locke and Mellon), in rats vitamin C alone or in any combination tried was ineffective. Gross and Cooper<sup>92</sup> produced pneumonia in rats by intratracheal infection with type III pneumococci and found a mortality of 85.7 per cent in the untreated group while the mortality in the rats treated with sulfanilamide was 23.1 per cent. Buttle and his associates<sup>93</sup> emphasized that the protection against pneumococci with sulfanilamide was in no instance comparable to that obtained in hemolytic streptococcic and meningococcic infections.

Kreidler<sup>93</sup> concluded that if sulfanilamide is given orally to rabbits in adequate doses early in the course of experimental dermal infection with *Pneumococcus* type I the drug eliminates the micro-organisms from the blood stream, reduces the fever, cures the local lesion and favors recovery in most of the treated animals. Branham and Rosenthal<sup>94</sup> on the basis of experiments on mice, found that therapy which combined the use of serum and sulfanilamide, on the whole, yielded better results in pneumococcic infections than therapy with either alone. Schmidt<sup>95</sup> expressed the belief that the work of Rosenthal<sup>96</sup> and Cooper, Gross and Mellon<sup>40</sup> justifies the use of sulfanilamide in treating infections with other types of pneumococci—IV to XXXII—and particularly those types for which potent antisera are not readily available. Schmidt's experiments demonstrated that sulfanilamide is

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91 Cooper, F. B., and Gross, P. Sulfanilamide, Antipneumococcus Serum and Vitamin C Therapy in Type II Pneumococcal Pneumonia of Rats, *Proc Soc Exper Biol & Med* **36** 774 (June) 1937.

92 Gross, P., and Cooper, F. B. Efficacy of *p*-Aminobenzenesulfonamide in Experimental Type III *Pneumococcus* Pneumonia in Rats, *Proc Soc Exper Biol & Med* **36** 225 (April) 1937.

93 Kreidler, W. A. Treatment of Pneumococcal Infections in Rabbits with Sulfanilamide, *Proc Soc Exper Biol & Med* **37** 146 (Oct) 1937.

94 Branham, S. E., and Rosenthal, S. M. Studies in Chemotherapy. V. Sulfanilamide, Serum, and Combined Drug and Serum Therapy in Experimental Meningococcus and Pneumococcus Infections in Mice, *Pub Health Rep* **52** 685 (May 28) 1937.

95 Schmidt, L. H. Use of Sulfanilamide in the Treatment of Type XIV *Pneumococcus* Infections in Mice, *Proc Soc Exper Biol & Med* **37** 205 (Oct) 1937.

effective as a therapeutic agent for the treatment of mice infected with type XIV pneumococci. Whitby<sup>76b</sup> found in the treatment of mice infected with type I pneumococci that the effectiveness of sulfanilamide was surpassed by two diaminoanilide compounds. Rosenthal,<sup>51</sup> as mentioned previously, stated that the bacteriostatic and bactericidal action of sulfanilamide on pneumococci in vitro is adequate to explain its chemotherapeutic effect on animals.

Buttle<sup>39c</sup> first demonstrated the protective and curative properties of sulfanilamide against meningococcic infections in mice. Proom<sup>74</sup> concluded that sulfanilamide was equally effective against group I and group II meningococci but noted a much lower degree of protection if the administration of the drug was delayed for a few hours. The early oral administration of the drug prevented the development of septicemia and death in mice infected with meningococci. He advised the prophylactic use of sulfanilamide in meningococcic epidemics, since in man, the spread of infection from the nasopharynx to the meninges is most probably via the blood stream. Rosenthal, Bauer and Branham<sup>45</sup> found that disulfanilamide (sulfanilylsulfanilamide, paraaminobenzene-sulfonylparaaminobenzenesulfonamide) administered subcutaneously was more effective than sulfanilamide, but they were able to confirm Proom's findings. Neter<sup>96</sup> demonstrated a bacteriostatic effect of sulfanilamide on meningococci present in spinal fluid obtained from patients with meningococcic meningitis. Levaditi and Vaisman<sup>97</sup> found that sulfanilamide was curative in experimental infections induced by meningococci (types A, B, and C) in mucin. Whitby<sup>76b</sup> found sulfon-anilide tartrate as effective as sulfanilamide in experimental meningococcic infections.

Buttle<sup>88</sup> reported the protection of mice against multiple lethal doses of *Bacterium typhosum* and *Bacterium paratyphosum* B with sulfanilamide. There was also some degree of protection against *Bacterium aertrycke*, Friedlander's bacillus, *Pasteurella pseudotuberculosis* and *Pasteurella septica*. In no instance, however, were the results of the treatment as satisfactory as in hemolytic streptococcic and meningococcic infections. Helmholz<sup>66c</sup> showed that with sulfanilamide in concentrations easily obtainable by oral administration the urine is rendered bactericidal for *Esch coli*, *Aerobacter aerogenes* and organisms of the proteus and *Pseudomonas* groups. The drug was strikingly ineffective against infections with *Str faecalis*. Albright, Dienes and Sulkowitch<sup>98</sup>

96 Neter, E. Bacteriostatic Action of Sulfanilamide upon Meningococcus in Spinal Fluid, *Proc Soc Exper Biol & Med* **38** 37 (Feb) 1938

97 Levaditi, C, and Vaisman, A. Chimiotherapie de l'infection meningococcique experimentale de la souris, *Compt rend Soc de biol* **125** 604, 1937

98 Albright, F, Dienes, L, and Sulkowitch, H W. Pyelonephritis with Nephrocalcinosis Caused by *Haemophilus Influenzae* and Alleviated by Sulfanilamide. Report of Two Cases, *J A M A* **110** 257 (Jan 29) 1938

found that sulfanilamide therapy promptly eliminated *Haemophilus influenzae* from the urine. Rosenthal<sup>51</sup> demonstrated the lack of effect of sulfanilamide upon the growth of *Staphylococcus albus* and *Esch coli*. Nitti, Bovet and Depierre,<sup>57</sup> Levaditi<sup>59b</sup> and Long and Bliss<sup>12f</sup> have shown that the drug is ineffective against the *Salmonella* types. Bliss and Long,<sup>99</sup> however, protected mice against intraperitoneal injections of *Clostridium welchii* by previously administering sulfanilamide by the same route. Campbell<sup>100</sup> found no evidence that sulfanilamide has an effect on experimental syphilis in the rabbit. Rich and Follis<sup>101</sup> have described an inhibitory effect of the drug on the development of experimental tuberculosis in the guinea pig. Negative results were obtained on mice with *Trypanosoma equiperdum* and on canaries with avian malaria.<sup>85</sup>

It is of some interest that the effect of sulfanilamide on the metabolism of bacteria was studied by Barron and Jacobs.<sup>102</sup> Since the oxidized forms (the original prontosil and prontosil soluble) were found devoid of bactericidal properties, it has been assumed that these drugs become active by their reduction in the animal body.<sup>11a</sup> Barron and Jacobs found that the original prontosil had no effect on the metabolism of hemolytic streptococci, *Bacillus coli*, Friedlander's bacillus or gonococci. Sulfanilamide had a slight inhibitory effect on the oxidation of dextrose by hemolytic streptococci and on the oxidation of dextrose and lactate by Friedlander's bacillus.

#### CLINICAL OBSERVATIONS AND DOSAGE

Long and Bliss<sup>16a</sup> at first concluded from their experimental and clinical observations on the treatment of streptococcic infections that about forty-eight hours is required before maximum therapeutic effects can be obtained with sulfanilamide or its derivatives. Because of this time factor, they recommended that treatment be instituted immediately in infections due to hemolytic streptococci. They also observed that striking results could not be expected for patients with far advanced infections or for those already moribund. They<sup>16</sup> were convinced that with hemolytic streptococcic meningitis, peritonitis or septicemia or with meningococcic meningitis or septicemia the gravity of the prognosis

99 (a) Long, P. H., and Bliss, E. A. Observations on Experimental and Clinical Use of Sulfanilamide in Treatment of Certain Infections, *Canad. M. A. J.* **37** 457 (Nov.) 1937. (b) Bliss and Long.<sup>54</sup>

100 Campbell, A. D. A Note on the Failure of Sulfanilamide to Affect Syphilis in the Rabbit, *Am. J. Syph., Gonorr. & Ven. Dis.* **21** 524 (Sept.) 1937.

101 Rich, A. R., and Follis, R. H. Jr. The Inhibitory Effect of Sulfanilamide on the Development of Experimental Tuberculosis in the Guinea Pig, *Bull. Johns Hopkins Hosp.* **62** 77 (Jan.) 1938.

102 Barron, E. S. G. and Jacobs, H. R. Effect of Prontosil and Prontylin on Metabolism of Bacteria, *Proc. Soc. Exper. Biol. & Med.* **37** 10 (Oct.) 1937.

warranted a disregard of all possible toxic effects of sulfanilamide in an attempt to control the infections as rapidly as possible. For patients weighing 100 pounds (45 Kg) or more, an initial dose of from ten to sixteen 5 grain (0.32 Gm) tablets was employed, the initial dose was intended to give a concentration of sulfanilamide in the blood of about 10 mg per hundred cubic centimeters within four hours. To maintain this level, three 5 grain (0.32 Gm) tablets were administered every four hours. Patients weighing from 50 to 90 pounds (23 to 41 Kg) were given an initial dose of six to ten 5 grain (0.32 Gm) tablets, followed by two or three 5 grain (0.32 Gm) tablets every four hours. For children weighing from 25 to 50 pounds (11 to 23 Kg) four to six 5 grain (0.32 Gm) tablets were used as an initial dose and one or two 5 grain (0.32 Gm) tablets employed every four hours as a maintenance dose. The maintenance dose may vary widely owing to the different rates of excretion in various persons.

In man, the absorption of sulfanilamide is apparently complete from the gastrointestinal tract in four hours. This is the basis for the selection of a four hour interval for maintenance doses. Subcutaneous administration of sulfanilamide is not followed by a higher concentration in the blood than is oral administration, so that parenteral administration is necessary only when the patient is nauseated or unconscious or fails to show a concentration of sulfanilamide in the blood of 8 to 10 mg per hundred cubic centimeters because of faulty absorption. For parenteral use, the required amount of sterile physiologic solution of sodium chloride is brought to the boiling point, and when boiling ceases 0.8 to 1 Gm of sulfanilamide is added for each hundred cubic centimeters of saline solution. The solution is agitated to facilitate solution of the sulfanilamide, cooled to 37 C and administered by hypodermoclysis. Long and Bliss<sup>16</sup> recommended that for adults the initial hypodermoclysis should consist of 500 cc of a 1 per cent solution, followed by 300 cc at eight hour intervals during the first twenty-four hours. Persons weighing from 50 to 90 pounds (23 to 41 Kg) received 200 to 400 cc as an initial dose, followed by 200 cc at eight hour intervals. An initial dose of 100 to 300 cc was administered to children weighing from 25 to 50 pounds (11 to 23 Kg) followed by 100 to 200 cc of the solution at eight hour intervals. The authors recommended that babies receive a total of 1 Gm of sulfanilamide per 10 pounds (4,540 Gm) of body weight during the first twenty-four hours. In most instances, because of the rapid absorption of sulfanilamide from the intestinal tract it would seem that intravenous injection of the drug is unnecessary.

In infections of the meninges, intrathecal use of the drug has been advocated. Sulfanilamide is not irritating to the meninges and may

be administered according to the technic employed for giving antiserums by this route. Since the drug is present in the cerebrospinal fluid within a few hours of administration by mouth and in concentration only slightly lower than that in the blood, the necessity for intrathecal administration is infrequent. For intrathecal use, a concentration of 0.8 to 1.0 per cent in physiologic solution of sodium chloride is used. After preliminary spinal drainage, 15 to 25 cc of this solution, at body temperature, is permitted to flow into the spinal canal by gravity. Positive pressure should never be employed, and the amount of sulfanilamide solution used should be 5 to 10 cc less than the amount of cerebrospinal fluid withdrawn.

As has been the case with most new therapeutic agents, overdosage has led to unnecessary side effects. Long and Bliss<sup>10</sup> found that moderately severe streptococcic infections in adults may be controlled by administering three 5 gram (0.32 Gm.) tablets of sulfanilamide at four hour intervals, while mild streptococcic infections may be controlled with one or two 5 gram (0.32 Gm.) tablets at four hour intervals. The amount of sulfanilamide should be decreased as soon as definite clinical improvement is noted. Increased doses should follow the absence of clinical improvement or the recurrence of the infection.

Schwentker, Clason, Morgan, Lindsay and Long<sup>81a</sup> regarded pionsol soluble as unsuitable for intraspinal injection because it was definitely irritating to the meninges and frequently caused a marked cellular reaction with a distinct elevation of temperature. They recommended surgical procedures to eradicate septic foci in cases of streptococcic meningitis as an adjunct to specific therapy, but since the patients are poor surgical risks they felt that extensive surgical intervention should not be resorted to until the infection has been brought under control by the specific therapy. Ballenger, Elder and McDonald<sup>103</sup> have suggested the use of artificial fever to supplement the use of a chemical agent after their excellent results in cases of resistant gonococcic infection. Their patients chosen for thermochemotherapy were persons who failed to respond to artificial fever or whom sulfanilamide failed to benefit.

Basman and Perley<sup>104</sup> emphasized the fact that one cannot rely on oral administration alone in treating very sick infants. They recommended supportive treatment in addition to sulfanilamide, suggesting isotonic sodium lactate, to relieve severe acidosis, lactate-Ringer and dextrose solutions, to relieve or prevent dehydration, and blood transfu-

103 Ballenger, E. G., Elder, O. F., and McDonald, H. P. Sulfanilamide and Thermochemotherapy in Gonococcic Infections. Preliminary Report, *J. A. M. A.* **109** 1037 (Sept. 25) 1937.

104 Basman, J., and Perley, A. M. Report of Patients Treated with Sulfanilamide at the St. Louis Children's Hospital, *J. Pediat.* **11** 212 (Aug.) 1937.



sions They investigated the solubility of crystalline sulfanilamide in Ringer's solution, lactate-Ringer solution, molar solution of racemic sodium lactate and 10 per cent dextrose solution Solutions of 0.25, 0.5, 0.75 and 1 per cent sulfanilamide were made in each of these solutions, heated one-half hour in a boiling water bath and allowed to cool All the solutions remained clear, and no change in hydrogen ion concentration was detectable in the isotonic solutions of sodium lactate or lactate-Ringer solution Long and Bliss<sup>105</sup> have suggested that in cases of severe infection in which the immediate prognosis is grave both parenteral and oral administration of sulfanilamide may be used For moderately severe infections either parenteral or oral administration may be employed For mild or relatively chronic streptococcal infections, oral administration alone is adequate and frequently one-half to two-thirds the estimated dose is effective

#### TOXIC MANIFESTATIONS

Reports of toxicity for experimental animals began to appear soon after the introduction of sulfanilamide and related compounds as chemotherapeutic agents The reports of deleterious effects in man and an increasing array of side effects have become so numerous as to outnumber case reports and perhaps result in overemphasis Domagk<sup>11</sup> reported that mice and dogs tolerate 0.5 Gm of the original prontosil given orally, while cats tolerate only 0.2 Gm per kilogram of body weight, the urine of dogs which were given varying amounts of the same drug over a period of fourteen days showed no red or white cells or casts Buttle, Gray and Stephenson<sup>39a</sup> found the original prontosil innocuous for mice when oral doses of 0.6 Gm per kilogram of body weight were used, larger doses, 1.25 and 5 Gm per kilogram, proved fatal to the majority of mice The experimenters gave sulfanilamide orally to mice and found that oral administration of 2.5 Gm per kilogram was well tolerated but that 5 Gm per kilogram killed 2 to 6 mice and 10 Gm killed every mouse The Tréfouels, Nitti and Bovet<sup>106</sup> found sulfanilamide to possess negligible toxicity for animals, a finding corroborated by Bloch-Michel<sup>34</sup> Proom,<sup>74</sup> using sulfanilamide in experimental work on animals, found it toxic when used intraperitoneally but administered it satisfactorily by mouth and subcutaneously Whitby<sup>76b</sup> and Halpern and Mayer<sup>107</sup> observed toxic properties, and the latter noted an effect on the nervous system In cases of acute poisoning, Hawking<sup>52</sup> found involvement of the central nervous system but the other organs presented no demonstrable change, large doses

105 Long and Bliss (footnotes 46a and 99a)

106 Trefouel, Trefouël, Nitti and Bovet (footnotes 12a and 56b)

107 Halpern, B. N., and Mayer, R. L. Toxicité expérimentale comparée de quelques substances antistreptococciques, *Presse med* 45 747 (May 19) 1937

in the peritoneal cavity had no irritating effect. Rosenthal<sup>108</sup> reported 6 Gm per kilogram of body weight given subcutaneously in olive oil to mice as the fatal dose. Two grams per kilogram produced spastic movements of the extremities, flexion of the spine, excitability and incoordination, which disappeared after twelve hours.

Raiziss, Severac and Moetsch<sup>79</sup> found that mice tolerated well subcutaneous doses of 1 to 2 Gm per kilogram of body weight, while 2.5 to 3 Gm proved a fatal dose. Hageman<sup>108</sup> gave mice large parenteral doses of sulfanilamide over a period of fourteen days, and at the end of that time 1 of the surviving animals was killed. Of the remaining mice, 1 was killed each week thereafter. The drug in large doses was not well tolerated, producing unsteadiness, incoordination, paralysis, acute anterior flexion of the spine, spastic extension of the legs, prostration, convulsions and sometimes death. When smaller doses were given, such symptoms were transient, coming on one-half to one hour after injection and disappearing in twelve to eighteen hours. Sulfanilamide suspended in saline solution when injected intraperitoneally into mice produced a fibroblastic foreign body reaction, with crystals scattered through the area of reaction, these areas appeared as milky white spots on the surfaces of the liver, spleen and peritoneum. The liver and kidneys, however, presented no pathologic change. Hemosiderin, in varying amounts, was found adjacent to the malpighian bodies, and the hemosiderin was roughly proportional to the size of the fatal dose and the duration of life after the onset of exposure. A greater incidence of eosinophils was noted in the bone marrow of the animals exposed to sulfanilamide. Barlow<sup>109</sup> found the 50 per cent oral minimum lethal dose for sulfanilamide given in suspension in acacia was 6.25 Gm per kilogram of body weight for mice, the minimum lethal dose for sulfanilamide given by the subcutaneous route was found to be 2.75 to 4 Gm per kilogram of body weight for mice.

Certain toxic manifestations with full doses of sulfanilamide or related compounds have been recognized since their first clinical use. Weakness, dizziness, tinnitus, lassitude, anorexia, general malaise, nausea, cyanosis, acidosis, sulfhemoglobinemia and fever were commonly encountered, but it was generally considered unnecessary to discontinue the drug when the milder symptoms appeared. Death following administration of sulfanilamide has been repeatedly reported in the literature. Frost<sup>110</sup> reported a case of sulfhemoglobinemia result-

108 Hageman, P. O. Toxicity of Sulfanilamide. A Study of the Pathological Lesions in White Mice, *Proc Soc Exper Biol & Med* **37** 119 (Oct) 1937.

109 Barlow, O. W. Relative Toxicities and Therapeutic Values of Three Chemotherapeutic Agents of Sulphonamide Type, *Proc Soc Exper Biol & Med* **37** 315 (Nov) 1937.

110 Frost, L. B. D. Sulfhemoglobinemia Following Antistreptococcal Therapy, *Lancet* **1** 510 (Feb 27) 1937.

ing in death Borst<sup>111</sup> Young,<sup>112</sup> Model,<sup>113</sup> Schwartz, Garvin and Koletsky<sup>114</sup> and Berg and Holtzman<sup>115</sup> reported deaths due to agranulocytosis O'Connell<sup>116</sup> reported a patient dying of edema of the glottis and agranulocytosis after receiving 365 grams (23.65 Gm) of sulfanilamide in a period of seven days, but more of the drug may have been taken unofficially Granulocytopenia following sulfanilamide therapy was reported by McIntosh, Wilcox and Wright<sup>117</sup> and Mitchell and Trachsler<sup>118</sup> Leukopenia due to sulfanilamide has been reported by Mossel,<sup>119</sup> Plumer,<sup>120</sup> Trumper<sup>121</sup> and Bigler, Clifton and Werner<sup>61</sup> Bigler<sup>122</sup> found that sulfanilamide never increased the leukocyte count, while a depression of the white blood cells was common, there being a marked absolute reduction of all the cellular elements without any characteristic relative change in the proportion of the different white blood cells as studied by the Schilling count

Harvey and Janeway<sup>123</sup> reported 3 cases in which acute hemolytic anemia developed during the administration of the drug, all 3 patients recovered promptly after blood transfusions Anemia, with the appearance of nucleated red blood cells, polychromasia and moderate anisoc-

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111 Borst, J G G Death from Agranulocytosis After Treatment with Prontosil Flavum, *Lancet* **1** 1519 (June 26) 1937

112 Young, C J Agranulocytosis and Para-Aminobenzenesulphonamide, *Brit M J* **2** 105 (July 17) 1937

113 Model, A Agranulocytosis and Para-Amino-Benzene-Sulfonamide, *Brit M J* **2** 295 (Aug 7) 1937

114 Schwartz, W F, Garvin, C F, and Koletsky, S Fatal Granulocytopenia from Sulfanilamide, *J A M A* **110** 368 (Jan 29) 1938

115 Berg, S, and Holtzman, M Fatal Granulocytopenia Following Sulfanilamide Therapy, *J A M A* **110** 370 (Jan 29) 1938

116 O'Connell, J T Sulfanilamide Poisoning Report of Fatal Case, *U S Nav M Bull* **36** 61 (Jan) 1938

117 McIntosh, R, Wilcox, D A, and Wright, F H Results of Sulfanilamide Treatment at the Babies Hospital, New York City, *J Pediat* **11** 167 (Aug) 1937

118 Mitchell, A G, and Trachsler, W H Report on the Use of Sulfanilamide and Its Derivatives at the Children's Hospital Cincinnati, *J Pediat* **11** 183 (Aug) 1937

119 Mossel, B F Studies on the Use of Prontylin in Rheumatic Fever, *New England J Med* **216** 487 (March 18) 1937

120 Plumer, H E Prontylin and Prontosil, *New England J Med* **216** 711 (April 22) 1937

121 Trumper, A Prontylin and Prontosil, *New England J Med* **216** 857 (May 13) 1937

122 Bigler, J A Blood Cell Response to Sulfanilamide Therapy, *Ann Otol Rhin & Laryng* **47** 219 (March) 1938

123 Harvey, A M, and Janeway, C A The Development of Acute Hemolytic Anemia During the Administration of Sulfanilamide (Para-Aminobenzenesulfonamide), *J A M A* **109** 12 (July 2) 1937

toxis, as the result of treatment with sulfanilamide was reported by Wembeig, Mellon and Shinn.<sup>119</sup> Kohn<sup>121</sup> reported the occurrence of acute hemolytic anemia during treatment with the drug. Cyanosis following administration of sulfanilamide was noted by Colebrook and Kenny,<sup>122</sup> Harvey and Janeway<sup>123</sup> and Marshall and Walzl.<sup>125</sup> Tarbell<sup>126</sup> described cyanosis with fever in a patient with diarrhea following sulfanilamide therapy.

Colebrook and Kenny<sup>122</sup> reported the occurrence of cyanosis and sulfhemoglobinemia in 3 patients treated with the original prontosil. All these patients had taken magnesium sulfate. Paton and Eaton<sup>127</sup> found that in most persons the administration of magnesium sulfate simultaneously with, or within two or three days preceding, the administration of sulfanilamide gives rise to sulfhemoglobinemia. They found the removal of sulfhemoglobin from the blood to be much slower than the removal of methemoglobin. The former could be detected six weeks after the administration of sulfanilamide ceased, while methemoglobin disappeared in about twenty-four hours. They felt that the detection of sulfhemoglobinemia is more accurately made by spectroscopic examination of the blood than by the clinical observation of cyanosis and recommended blood transfusion if the patient's life is endangered, since oxygen, although of some value in methemoglobinemia, is of no value in cases of severe sulfhemoglobinemia. Archer and Discombe<sup>128</sup> found that any treatment producing a liquid stool accelerates the formation of sulfhemoglobinemia. The combination of hemoglobin with the hydrogen sulfide absorbed from the intestinal tract results in intracorpuseular sulfhemoglobinemia, the reaction is catalyzed by the drug circulating in the blood. Purgation diminishes the normal absorption of protein products of digestion in the small intestine, resulting in increased putrefaction in the colon and a production of hydrogen sulfide in great excess. Archer and Discombe stated that the development of sulfhemoglobinemia can be prevented or delayed by cleansing the colon with enemas before treatment is started, by using a low residue diet of adequate caloric value, by eliminating eggs from the diet and by giving regular large doses of liquid petrolatum.

124 Kohn, S. E. Acute Hemolytic Anemia During Treatment with Sulfanilamide, *J. A. M. A.* **109** 105 (Sept. 25) 1937.

125 Marshall, E. K., Jr., and Walzl, E. M. Cyanosis from Sulfanilamide, *Bull. Johns Hopkins Hosp.* **61** 140 (Aug.) 1937.

126 Tarbell, H. A. Sulfanilamide Must Be Used with Care. Case Report, *J. M. Soc. New Jersey* **34** 506 (Aug.) 1937.

127 Paton, J. P. J., and Eaton, J. C. Sulfhemoglobinemia and Methemoglobinemia Following Administration of *p*-Aminobenzenesulfonamide, *Lancet* **1** 1159 (May 15) 1937.

128 Archer, H. E., and Discombe, G. Sulfhemoglobinemia. Its Cause and Prevention, with Especial Reference to Treatment with Sulfanilamide, *Lancet* **2** 432 (Aug. 21) 1937.

Colebrook and Kenny<sup>77a</sup> and Whitby<sup>76b</sup> noted the occurrence of sulfhemoglobinemia. Discombe<sup>129</sup> observed sulfhemoglobinemia in 6 of 7 patients receiving over 5 Gm of the drug, association with magnesium sulfate was shown in all 6 cases, and in 1 the salt was merely used as a skin dressing. Colebrook and Purdie<sup>130</sup> in examining the blood of 53 patients with cyanosis following sulfanilamide therapy found sulfhemoglobinemia in 13, methemoglobinemia in 24 and both in 8. Methemoglobinemia following administration of sulfanilamide was considered and reported by Dees and Colston,<sup>66g</sup> Paton and Eaton,<sup>127</sup> Kenny<sup>131</sup> and Hageman<sup>132</sup>. Bensley and Ross<sup>133</sup> demonstrated that methemoglobinemia is not necessarily related to the amount of the dose of sulfanilamide, and that in some cases anoxemia may be aggravated by anemia or methemoglobinemia. Mull and Smith<sup>134</sup> described a patient who suffered not only a sharp drop in the oxygen content of the blood but also a distinct fall in the capacity of the blood for absorbing oxygen. The blood showed a peculiar color when aerated, never attaining the bright red of normal oxygenated blood. Marshall and Walzl<sup>125</sup> found that clinical cyanosis does not necessarily involve a decrease in oxygen-carrying capacity of the blood or the presence of nonfunctional iron pigment and stated that a black oxidation product of the drug stained the erythrocytes.

The occurrence of acidosis during sulfanilamide therapy has been discussed at length by Southworth,<sup>135</sup> Dees and Colston<sup>66g</sup> and Harvey and Janeway<sup>123</sup>. Borst<sup>111</sup> reported the occurrence of thrombopenic purpura following sulfanilamide therapy. Schonberg<sup>136</sup> observed purpuric and scarlatiniform eruption in 1 case in which one 5 gram

129 Discombe, G. Sulfhemoglobinemia Following Sulfanilamide Treatment, *Lancet* **1** 626 (March 13) 1937

130 Colebrook, L., and Purdie, A. W. Treatment of One Hundred and Six Cases of Puerperal Fever by Sulphanilamide (Streptocide), *Lancet* **2** 1237 (Nov 27), 1291 (Dec 4) 1937

131 Kenny, M., Johnston, F. D., von Haebler, T., and Miles, A. A *p*-Aminobenzenesulphonamide in Treatment of Bacterium Coli Infections of Urinary Tract, with Note on Two-Plate Bacterial Count, *Lancet* **2** 119 (July 17) 1937

132 Hageman, P. O. Clinical Experience in the Use of Sulfanilamide at the New Haven Hospital, *J. Pediat* **11** 195 (Aug) 1937

133 Bensley, E. H., and Ross, J. B. Methaemoglobinemia Due to Sulphanilamide, *J. A. M. A.* **109** 1035 (Sept 25) 1937

134 Mull, J. W., and Smith, J. T. Effect of Sulfanilamide on the Oxygen Capacity of the Blood, *J. A. M. A.* **110** 439 (Feb 5) 1938

135 Southworth, H. Acidosis Associated with the Administration of Para-Aminobenzene-Sulphonamide (Prontylin), *Proc. Soc. Exper. Biol. & Med.* **36** 58 (Feb) 1937

136 Schonberg, I. L. Purpuric and Scarlatiniform Eruption Following Sulfanilamide, *J. A. M. A.* **109** 1035 (Sept 25) 1937

(0.32 Gm) tablet precipitated marked allergic symptoms. Hageman and Blake<sup>137</sup> reported a case in which thrombopenic purpura developed after the patient had taken sulfanilamide, phenyl salicylate and acetophenetidin in small doses while being treated for pharyngitis and cervical adenitis. Newman and Sharlit<sup>138</sup> reported the photosensitizing action of sulfanilamide on the skin. They found that withdrawal of both the drug and sunlight resulted in complete disappearance of the eruption before the sensitizing influence of the irradiation had been dissipated. Brunsting,<sup>139</sup> Menville and Archinard,<sup>140</sup> Frank,<sup>141</sup> Grosjean<sup>142</sup> and Colebrook and Purdie<sup>143</sup> have commented on the occurrence of this photosensitizing action of the drug.

Menville and Archinard<sup>140</sup> described 4 cases with maculopapular eruption, associated with severe itching and the formation of minute unerupted vesicles. In 1 case the rash was associated with severe chills, fever and leukocytosis. The rash disappeared within several days when the drug was discontinued. Goodman and Levy<sup>143</sup> reported 2 cases of toxicodermatosis, in 1 of which hemorrhagic lesions developed, an indication that sulfanilamide may have a vasculotoxic property. Schwentker and Gelman<sup>144</sup> observed the development of a rash in 10 of 180 patients. In some cases, the rash was recognized as early as the third day of medication. In one half of the cases, the rash appeared between the tenth and the fourteenth day. The eruption was morbilliform and made up of maculopapular lesions, brownish and slightly raised. Almost the entire surface of the body was covered, but at times the lesions were limited to the buttocks and legs. Occasionally, the eruption was seen on the palms of the hand and soles of the feet, while the mucous membranes were unaffected. The eruption faded rapidly after the drug was discontinued.

137 Hageman, P. O., and Blake, F. G. Clinical Experience with Sulfanilamide in the Treatment of Beta Hemolytic Streptococcal Infections, *Am J M Sc* **195** 163 (Feb) 1938.

138 Newman, B. A., and Sharlit, H. Sulfanilamide Photosensitizing Agent of the Skin, *J A M A* **109** 1036 (Sept 25) 1937.

139 Brunsting, L. A. Sulfanilamide Dermatitis. Question of Relation to Photosensitivity, *Proc Staff Meet, Mayo Clin* **12** 614 (Sept 29) 1937.

140 Menville, J. G., and Archinard, J. J. Skin Eruptions in Patients Receiving Sulfanilamide. Report of Four Cases, *J A M A* **109** 1008 (Sept 25) 1937.

141 Frank, L. J. Dermatitis from Sulfanilamide, *J A M A* **109** 1011 (Sept 25) 1937.

142 Grosjean, W. A. The Sun and Sulfanilamide, *J A M A* **109** 1382 (Oct 23) 1937.

143 Goodman, M. H., and Levy, C. S. The Development of Cutaneous Eruption (Toxicodermatosis) During the Administration of Sulfanilamide. Report of Two Cases, *J A M A* **109** 1009 (Sept 25) 1937.

144 Schwentker, F. F., and Gelman, S. Sulfanilamide Rash, *Bull Johns Hopkins Hosp* **61** 136 (Aug) 1937.

Schwentker, Gelman and Long<sup>145</sup> occasionally noted a morbilliform rash in patients given the drug for streptococcic infections. Such a rash was noted by Hageman<sup>132</sup> and appeared in one half of his cases in which a febrile complication followed the use of the drug. Severe dermatitis medicamentosa was reported by Finney,<sup>146</sup> and Myers<sup>147</sup> reported exfoliative dermatitis following administration of sulfanilamide. Morbilliform eruptions and hyperpyrexia during the course of sulfanilamide therapy have been reported by Unshelm,<sup>651</sup> Hageman and Blake<sup>148</sup> and Mainzer.<sup>149</sup> It is generally agreed that the drug should be withdrawn with the development of jaundice or fever not attributable to the infection. Myers<sup>147</sup> obtained a positive patch test in his case of exfoliative dermatitis. Mitchell and Trachsler<sup>118</sup> observed maculopapular and morbilliform rashes. Hypersensitivity to sulfanilamide with urticarial lesions was described by Salvin.<sup>150</sup>

Fever due to administration of sulfanilamide was noted by Menville and Archinard,<sup>140</sup> Recknagel,<sup>19</sup> Tarbell,<sup>126</sup> Harvey and Janeway,<sup>123</sup> Grutz,<sup>151</sup> Felke,<sup>152</sup> Hageman<sup>132</sup> and Colebrook and his co-workers.<sup>153</sup> Hageman and Blake<sup>148</sup> observed a febrile reaction to sulfanilamide in 21 of 134 cases. The appearance of fever complicates differential diagnosis, and Hageman and Blake considered the similarity of the febrile response and associated reactions to those of serum sickness. Colebrook and Kenny<sup>120</sup> and Whitby<sup>76b</sup> observed some irritation of the kidney by sulfanilamide. Hageman and Blake<sup>137</sup> found retention of nitrogen in 3 cases. In 2 the condition promptly subsided when the drug was withdrawn. In the third acute nephritis was present when the treatment was started, uremia later developed, and the patient died. A case of hematuria following large doses of prontosil and sulfanilamide was reported by Mitchell and Trachsler.<sup>118</sup>

145 Schwentker, F. F., Gelman, S., and Long, P. H. The Treatment of Meningococcic Meningitis with Sulfanilamide. Preliminary Report, *J. A. M. A.* **108** 1407 (April 24) 1937.

146 Finney, J. O. Severe Dermatitis Medicamentosa Following the Administration of Sulfanilamide, *J. A. M. A.* **109** 1982 (Dec 11) 1937.

147 Myers, G. B., Vonder Heide, E. C., and Balcerski, M. Exfoliative Dermatitis Following Sulfanilamide, *J. A. M. A.* **109** 1983 (Dec 11) 1937.

148 Hageman, P. O., and Blake, F. G. Specific Febrile Reaction to Sulfanilamide. Drug Fever, *J. A. M. A.* **109** 642 (Aug 28) 1937.

149 Mainzer, F. S. Sulfanilamide Rash, *Pennsylvania M. J.* **41** 386 (Feb) 1938.

150 Salvin, M. Hypersensitivity to Sulfanilamide, *J. A. M. A.* **109** 1038 (Sept 25) 1937.

151 Grutz, O. Neue Grundlegung für die Gonorrhoebehandlung, *München med. Wchnschr.* **84** 1201 (Jul 30) 1937.

152 Felke, H. Die Chemotherapie der Gonorrhoe, *Deutsche med. Wchnschr.* **63** 1393 (Sept 10) 1937.

153 Colebrook and Kenny -- Colebrook and Purdie<sup>130</sup>

The occurrence of nausea, anorexia and diarrhea indicates a certain amount of reaction to the drug on the part of the gastrointestinal tract. Diarrhea was noted by Taibell,<sup>126</sup> Recknagel<sup>19</sup> and Bucy.<sup>154</sup> Schneider<sup>155</sup> observed an unusually violent reaction, not only in the smooth muscle of the rectum, but also in the uterus and the bladder. Colebrook and Kenny<sup>126</sup> and Long and Bliss<sup>127</sup> noted an effect on the lower intestinal tract resulting in the urge to defecate. Harvey and Janeway<sup>127</sup> reported a depression of hepatic function, as determined by biomsulphalein tests. Hageman and Blake<sup>137</sup> described the occurrence of toxic hepatitis in 1 patient with probable chronic cholecystitis, recovery followed withdrawal of the drug.

Effects on the nervous system are relatively uncommon, but mental confusion was noted by Paton and Eaton<sup>127</sup> and the occurrence of toxic neuritis was reported by Bucy.<sup>154</sup> Hogan<sup>156</sup> observed psychosis precipitated by sulfanilamide in a case of gonococcic infection of the prostate in which treatment was continued over a period of three weeks. Nine hundred and forty grams (61 Gm) was given during the first course and 280 grams (18 Gm) during the second course, but the patient at no time received over 80 grams (5 Gm) per day. The psychotic picture was first characterized by mild paranoid feelings, with apprehension and restlessness, later the psychosis became acute, with auditory and visual hallucinations. Improvement followed withdrawal of the drug. Clinical experience has shown that in most instances the milder toxic manifestations rapidly recede with reduction of the dose or withdrawal of the drug.

#### SULFANILAMIDE THERAPY FOR OTOLARYNGOLOGIC AND OTHER INFECTIONS

Because otolaryngologists are so frequently faced with the complicating factors of meningitis and septicemia, both preoperatively and postoperatively, the announcement of a new drug with undoubted value in the treatment of these dangerous infectious conditions commanded immediate attention. It was only by clinical trial, however, that the actual value of the drug could be estimated. Because of the excellent therapeutic effect of the drug on infections with beta hemolytic streptococci in animals, it was natural that its application to similar infections in man should be widely attempted. The evaluation of the curative effects of sulfanilamide is difficult on the basis of many case reports,

154 Bucy, P. C. Toxic Optic Neuritis Resulting from Sulfanilamide, *J. A. M. A.* **109** 1007 (Sept. 25) 1937.

155 Schneider, E. Unerwartete Wirkung von Prontosil auf glattemuskuläre Organe, *Zentralbl. f. Gynak.* **60** 1832 (Aug. 1) 1936.

156 Hogan, B. W. Psychosis Precipitated by Sulfanilamide, *U. S. Nav. M. Bull.* **36** 60 (Jan.) 1938.



since other forms of treatment are so frequently administered at the same time as the drug and in many instances the latter is used only because of the severity or hopelessness of the infection

*Pharyngitis and Tonsillitis*—It is of interest to note that Brenne-mann<sup>157</sup> found in practically every case of a carrier of hemolytic streptococci sterile cultures for hemolytic streptococci, usually within twenty-four hours after the administration of sulfanilamide. In every case, however, the cultures again became positive one to six days after the drug was stopped.

The opinion of the majority of authors seems to attribute a favorable effect to the drug in both pharyngitis and tonsillitis when the infection is primarily due to hemolytic streptococci. The temperature usually regained a normal level within a few hours to three days after administration of the drug, but beta hemolytic streptococci, when present, persisted in the cultures of material from the throat in some instances for as long as four or five weeks. Watson-Williams,<sup>158</sup> however, while conceding the beneficial effect of sulfanilamide in 11 cases of streptococcic tonsillitis, found the results no better than those obtained with sodium salicylate. His results in the treatment of pharyngitis were good. Long and Bliss<sup>159</sup> reported cures in 14 cases of tonsillitis and 5 cases of peritonsillar infection. Waring and Rettberg<sup>159</sup> found the drug beneficial in the treatment of streptococcic sore throat. Smith<sup>160</sup> stated that sulfanilamide had no prophylactic value in checking the spread of tonsillitis under epidemic conditions but was valuable in the treatment of streptococcic tonsillitis, he again noted that although infections with hemolytic streptococci were amenable to treatment with sulfanilamide, infections with *Str. viridans* were little if at all, affected.

Kenny and his co-workers<sup>161</sup> reported the development of tonsillitis in 2 patients who were being treated with the drug for bacteriuria. The immediate results of sulfanilamide therapy were good in 7 cases of tonsillitis reported by Hageman,<sup>162</sup> but hemolytic streptococci persisted in the cultures of material from the throat for as long as five weeks. Gallagher<sup>161</sup> treated 33 patients with epidemic streptococcic pharyngitis

157 Brenne-mann, J. Report on Sulfanilamide from the Children's Memorial Hospital of Chicago, *J. Pediat.* **11** 238 (Aug.) 1937.

158 Watson-Williams, E. Sulfanilamide in Treatment, *Bristol Med-Chir. J.* **54** 209, 1937.

159 Waring, J. J., and Rettberg, W. A. Sulfanilamide in Treatment of Streptococcic Infections. Good Effects and Bad Effects, *Rocky Mountain M. J.* **35** 26 (Jan.) 1938.

160 Smith, A. Chemotherapy of Streptococcic Infections, *Lancet* **2** 1064 (Nov. 6) 1937.

161 Gallagher, J. R. Observations on the Therapeutic Value of Sulfanilamide in Beta-Hemolytic-Streptococcic Pharyngitis, *Am. J. M. Sc.* **194** 830 (Dec.) 1937.

caused by strains of beta hemolytic streptococci of low virulence for mice. He found that the administration of doses of the drug equivalent to 1 Gm of sulfanilamide per 10 Kg of body weight early in the course of the disease apparently shortened the length of time during which cultures of material from the throat continued to reveal the bacteria. Basman and Perley<sup>164</sup> reported marked clinical improvement with some decrease in temperature when sulfanilamide was given in adequate doses. Pollock<sup>162</sup> stated that in 2 cases of hemolytic streptococcic sore throat the temperature dropped to normal within twelve hours and recovery was rapid and uneventful. McIntosh<sup>117</sup> found no striking effect on the clinical course of peritonsillar abscess when sulfanilamide was used. The drug may be of value when administered early in the course of the infection, but in the hands of most clinicians it has consistently failed to be effective after suppuration occurs.

*Vincent's Infection*—Sinclair<sup>163</sup> found sulfanilamide of no value in Vincent's infection when used topically. No effect on Vincent's infection has been observed when the drug is administered by mouth.

*Ludwig's Angina*—A 3 year old child with Ludwig's angina was treated with sulfanilamide by Fulghum<sup>164</sup>. The progress of the disease was arrested, and gradual regression of the swelling, without formation of pus, followed, with rapid return to a normal condition. On the other hand, Long and Bliss<sup>165</sup> had 2 patients with Ludwig's angina who died within twenty and thirty-five hours respectively after the beginning of treatment with the drug.

*Other Oral Infections*—Sinclair<sup>163</sup> reported that the powdered form of sulfanilamide was "successfully" applied in "dry socket," infected compound fracture of the mandible and osteomyelitis of the mandible. Livingston<sup>165</sup> was impressed with the effects of the drug in acute and subacute peridental and periapical infections involving extractions, reporting 5 cases but offering no convincing evidence that there was any benefit. Paul<sup>166</sup> used prontosil album (sulfanilamide) to advantage in a case of osteomyelitis of the mandible. Gauss<sup>167</sup> reported the relief

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162 Papers presented at the meeting of the Chicago Laryngological and Otological Society, Oct 4, 1937, Ann Otol, Rhin & Laryng 46:1124 (Dec) 1937

163 Sinclair, J. A. Preliminary Report on the Local Use of Sulfanilamide in the Treatment of Oral Lesions, J Canad Dent A 3:571 (Nov) 1937

164 Fulghum, J. E. Sulfanilamide Treatment of Ludwig's Angina, U S Nav. M Bull 36:58 (Jan) 1938

165 Livingston, A. Prontosil Album, Brit Dent J 62:638 (June 15) 1937.

166 Paul, A. Sur un cas d'ostéomyélite mandibulaire au cours de la grossesse, Rev de stomatol 39 819 (Nov) 1937

167 Gauss, E. Ueber die Verwendung von Prontosil in der Zahnheilkunde, Zahnärztl Rundschau 46 1813 (Oct 17) 1937

of pain and retrogression of inflammatory symptoms in cases involving periodontitis, subperiosteal abscess, difficult eruptions or infected wounds. The course of stomatitis was arrested and favorable results were obtained in the treatment of stomatitis aphthosa. Feise<sup>168</sup> in a report based on experience with 50 cases, including subperiosteal and submucous abscesses of the maxillas and mandible, abscesses of the floor of the mouth, phlegmons, parotitis and various forms of stomatitis and paradontosis, concluded that the course and duration of the disease was favorably influenced in each instance and that operative intervention was frequently rendered unnecessary.

*Adenitis*—Sulfanilamide appears to have little effect on suppurative adenitis, while favorable results may be encountered in the treatment of nonsuppurative adenitis. McIntosh<sup>117</sup> in a case of nonsuppurative adenitis observed the temperature fall to normal within forty-eight hours and the swelling of the glands subside rapidly, being impalpable in one week, in a second case, however, he obtained questionable results with the drug. In 2 cases of suppurative adenitis questionable results were presented. Hageman<sup>132</sup> found that in 1 of 7 cases of cervical adenitis in which treatment with sulfanilamide was employed incision and drainage were required. Relapse occurred in 1 instance, but response to a second course of the drug was satisfactory. In the remaining cases the condition subsided promptly. A review of the case reports makes it evident that adenitis due to the beta hemolytic streptococcus may or may not be amenable to treatment with sulfanilamide but that when surgical drainage is required the temperature remains elevated until drainage is accomplished.

*Otitis Media*—In regard to otitis media the situation is too complex for satisfactory evaluation of the drug. Paracentesis was performed early in some instances, late in others. In general, results were better when the hemolytic streptococcus was present in pure culture than when mixed infections occurred. There is as yet no evidence that the drug prevents extension of the infection from the middle ear to the mastoid cells, although pediatricians in general feel that fewer mastoid infections followed infections of the middle ear when treatment with sulfanilamide was employed during the winter of 1937-1938. Watson-Williams<sup>158</sup> expressed the opinion that sulfanilamide is of definite value in the control of infections of the middle ear. Carey<sup>169</sup> treated 8 patients suffering from acute otitis media with adequate doses of the drug. Two

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168 Feise, U. Ueber die Anwendung von Prontosil in der zahnärztlichen Chirurgie, Deutsche zahnärztl. Wchnschr. **40** 307 (April 2) 1937.

169 Carey, B. W., Jr. The Use of Para-Aminobenzenesulfonamide and Its Derivatives in Treatment of Infections Due to the B-Streptococcus Hemolyticus, the Meningococcus and the Gonococcus, J. Pediat. **11** 202 (Aug.) 1937.

of the 8 required mastoidectomy Hageman and Blake<sup>137</sup> found that otitis media in 11 patients subsided promptly with sulfanilamide therapy and that mastoiditis did not develop in any instance after treatment was started Long and Bliss<sup>16</sup> found that hemolytic streptococcic otitis media was very responsive to treatment with sulfanilamide Livingston<sup>162</sup> found inadequate doses or too early cessation of administration of the drug responsible for some failures in the treatment of otitis media but observed 7 cases of acute suppurative otitis media in which no benefit was obtained by adequate doses Basman and Perley<sup>104</sup> treated 9 patients with otitis media without mastoiditis, and in no instance did the infection go on to mastoiditis Long and Bliss<sup>47a</sup> used sulfanilamide alone in the treatment of pneumococcic otitis media and mastoiditis They observed that the drug has one-half the chemotherapeutic effect on pneumococcic infections that it has on hemolytic streptococcic infections of the middle ear and mastoid

*Mastoiditis*—The large number of cases of mastoiditis in the literature in which a favorable result with sulfanilamide therapy is reported may be somewhat misleading It must be remembered that in many cases mastoiditis subsided without operation before sulfanilamide was available In 64 cases in which a favorable reaction to the drug was reported 53 patients came to operation because it was indicated Sulfanilamide seems to be of value, however, in those instances in which meningeal irritation is in evidence Six patients with 2,000 to 4,000 cells in the cerebrospinal fluid and with destructive mastoiditis recovered without operation The drug appears to be effective also in treating the cellulitis about mastoid wounds and above all in dealing with the complicating factors of meningitis and septicemia, especially when they are due to the beta hemolytic streptococci In most instances exenteration of mastoid cells and, in the presence of infection of the blood stream, ligation of the internal jugular vein cannot be superseded by the administration of the drug alone .

Bernstein<sup>170</sup> obtained good clinical results with sulfanilamide in 5 cases of otitis media with mastoiditis All 5 patients were operated on Postoperative cellulitis and erysipeloid lesions responded well to the drug In 1 case favorable results were obtained although a non-hemolytic streptococcus was cultured from the mastoid wound and cellulitis developed postoperatively Long and Bliss<sup>16</sup> found that patients with acute hemolytic streptococcic mastoiditis were especially benefited during the postoperative course by adequate doses of sulfanilamide In 1 of their cases, death occurred in spite of mastoidectomy, secondary mastoidectomy, exploration of the petrous portion of the temporal bone

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170 Bernstein, S. S. Report on the Use of Sulfanilamide at the Children's Hospital of Michigan, *J. Pediat.* **11**:198 (Aug.) 1937

and adequate doses of sulfanilamide. The streptococci isolated from the patient were susceptible *in vitro* to the bacteriostatic effects of the drug. In a case of an adult the danger of discontinuing therapy too soon was demonstrated, meningeal invasion took place on the fourth day after treatment was stopped, but recovery followed resumption of the drug. In this case the drop in the carbon dioxide-combining power to 15.5 volumes per cent after 111 hours of treatment illustrated the effects of omitting base with sulfanilamide therapy. The normal carbon dioxide-combining power was soon reestablished with intensive alkali therapy. A third patient recovered promptly from hemolytic streptococcic meningitis secondary to otitis media when the drug was used.

Basman and Perley<sup>104</sup> noted that the outstanding feature of sulfanilamide therapy in the treatment of mastoiditis was the smooth post-operative course with lack of complications. They used sulfanilamide therapy in 15 cases of otitis media with mastoiditis. In 13 operation was performed, and in 2 the condition subsided without requiring operation. Hageman and Blake,<sup>137</sup> using the drug in 15 cases of mastoiditis, found mastoidectomy necessary in 2, and all the patients recovered. Neal and Appelbaum<sup>171</sup> reported 4 deaths in a series of 17 patients with otitis media and mastoiditis treated with sulfanilamide. Carey<sup>169</sup> reported no deaths in 4 patients with mastoiditis complicated by meningitis. Beta hemolytic streptococci were cultured from the mastoid wound in every case and from the cerebrospinal fluid in 2. The cerebrospinal fluid became sterile after twenty-four hours of treatment in each case, and in every instance the temperature became normal after the fifth day of sulfanilamide therapy. A patient with perisinal abscess complicating mastoiditis made an uneventful recovery when the perisinal abscess was drained at the time of the mastoidectomy and prontosil soluble and sulfanilamide were used immediately after operation. Brennemann<sup>157</sup> treated a mastoid abscess due to *Staph aureus* with sulfanilamide for eight days, at which time the mastoid abscess had ceased to drain but the ear continued to drain.

Shambaugh<sup>162</sup> described a case in which paralysis of the sixth nerve developed one week after mastoidectomy. A profuse discharge from the middle ear continued for four months, although the mastoid incision healed within a few weeks of the operation. The paralysis of the sixth nerve disappeared, but roentgenograms showed a large area of cellular destruction in the petrous apex. Twenty-four hours after administration of sulfanilamide was begun, the discharge ceased, and the hearing became normal two weeks later. Jordan<sup>162</sup> reported the recovery of 3 patients for whom mastoidectomy was indicated when prontosil soluble was administered. Livingston<sup>162</sup> reported 5 cases of mastoiditis in which by the usual standards mastoidectomy would have been performed. All

<sup>171</sup> Neal, J. B., and Appelbaum, E. Experience with Sulfanilamide in Meningitis, *Am J M Sc* **195** 175 (Feb) 1938.

the patients recovered promptly with sulfanilamide therapy. In pointing out that sulfanilamide may reduce the necessity of operative procedures, Livingston noted that in one hospital service 76 mastoidectomies were performed in 1935 and 59 in 1936, while in 1937 only 22 were done. In emphasizing the fact that not all the patients treated with sulfanilamide were benefited, he stated that the cases in which treatment was unsuccessful divided themselves into two groups. In the first, inadequate doses were given. The second comprised 7 cases of acute suppurative otitis media in which proper administration of sulfanilamide seemed to exert no beneficial effect.

*Otogenic Meningitis*—The most convincing evidence of the effectiveness of sulfanilamide therapy in man has accrued from the clinical observations in cases of beta hemolytic streptococcic meningitis. Gray,<sup>172</sup> in 1935, reviewed the literature on streptococcic meningitis for the period from 1901 to 1935 and found 66 cases in which recovery was recorded. Tripoli<sup>173</sup> reported a mortality of 91.6 per cent, while Gray estimated the mortality at 97 per cent. Trachsler and his co-workers,<sup>174</sup> reviewing the literature to June 1937, found 39 instances of recovery in addition to the 66 reviewed by Gray and added 5 of their own, making a total of 110 recoveries. The number of recoveries from streptococcic meningitis since sulfanilamide has been available now exceeds the total number from 1901 to 1937.

The drug should obviously effect excellent clinical results in cases of meningitis due to the beta hemolytic streptococcus, but its value against other types of meningitis could not be accurately predicted. Many authors<sup>175</sup> had shown that sulfanilamide was an effective agent for treating human infections due to the beta hemolytic streptococcus. Mellon, Gross and Cooper<sup>176</sup> showed that the marked therapeutic effect of both prontosil soluble and sulfanilamide against hemolytic streptococci obtained for strains of both medium and high virulence. They

172 Gray, H. J. Streptococcus Meningitis. Report of a Case with Recovery, J. A. M. A. **105** 92 (July 13) 1935.

173 Tripoli, C. J. Bacterial Meningitis. Comparative Study of Various Therapeutic Measures, J. A. M. A. **106** 171 (Jan 18) 1936.

174 Trachsler, W. H., Frauenberger, G. S., Wagner, C., and Mitchell, A. G. Streptococcic Meningitis with Special Emphasis on Sulfanilamide Therapy, J. Pediat. **11** 248 (Aug.) 1937.

175 Patterson, D. C. Experience with Prontosil and Prontylin, J. Connecticut M. Soc. **1** 358 (Aug.) 1937. Gardner W. W. Case Report Streptococcus Hemolyticus Infection Treated with Sulfanilamide, New York State J. Med. **37** 1673 (Oct. 1) 1937. Willson, P. Beta-Hemolytic Streptococcus Infection Treated with Para-Aminobenzenesulfonamide. Case, M. Ann. District of Columbia **6** 153 (June) 1937. Long and Bliss<sup>46</sup>. Colebrook and Kenny<sup>77a</sup>. Raiziss, Severac and Moetsch<sup>79</sup>. Footnote 81f. Peters and Havard<sup>81g</sup>. Waring and Rettberg<sup>159</sup>.

176 Mellon, R. R., Gross, P., and Cooper, F. B. Sulfanilamide and Prontosil in Hemolytic Streptococcus Infection, J. A. M. A. **108** 1858 (May 29) 1937.

also found that the drug resulted in localization and rapid healing of experimental intradermal hemolytic streptococcic infections, which in the untreated animal may disseminate with fatal results. Caussé, Loiseau and Gisselbrecht<sup>177</sup> reported in February 1936 the first recovery resulting from the use of the new drug. Arnold<sup>178</sup> reported a case of hemolytic streptococcic meningitis with mastoiditis and peripheral facial paralysis prior to operation. After sulfanilamide therapy, cultures of the spinal fluid became sterile in four days and had become sterile twenty-four hours before mastoidectomy was performed. The marked reduction in the cell count of the spinal fluid corroborated Schwentker's findings that the drug itself produces no cellular response in the leptomeninges. In this case the inflammatory reaction of the leptomeninges was greatly decreased after one intraspinal injection. Arnold suggested that intraspinal injection be continued until three negative cultures were obtained and that oral administration be continued ten days after the last positive culture of the spinal fluid. He was uncertain (February 1937) whether or not parenteral and oral administration of the drug would control infection in the central nervous system without intraspinal injection.

Lucas,<sup>179</sup> Vitenson and Konstam,<sup>180</sup> Schwentker and others,<sup>81a</sup> Draeseke and Raynor,<sup>181</sup> Martin and Delaunay,<sup>182</sup> Frazer,<sup>183</sup> Millet<sup>184</sup> and Long and Bliss<sup>16</sup> have reported the successful treatment of hemolytic streptococcic meningitis. Watson-Williams<sup>158</sup> treated 3 patients with such meningitis, of whom 2 died. Thompson<sup>185</sup> and Folsom<sup>186</sup>

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177 Causse, Loiseau and Gisselbrecht. Meningite purulente otogene a streptocoques hemolytiques, traitee exclusivement par un colorant azoique, *Guerison, Ann d'oto-laryng*, February 1936, p 194

178 Arnold, J G, Jr. Treatment of Hemolytic Streptococcus Meningitis with Para-Amino-Benzene-Sulfonamide, *Ann Int Med* **10** 1198 (Feb) 1937

179 Lucas, C F. Haemolytic Streptococcal Meningitis Treated with Prontosil Recovery, *Brit M J* **1** 557 (March 13) 1937

180 Vitenson, I, and Konstam, G. Case of Streptococcal Meningitis Treated with Prontosil, *Lancet* **1** 870 (April 10) 1937

181 Draeseke, G C, and Raynor, E F. Case of Streptococcal Meningitis Treated with Prontosil, *Canad M A J* **36** 618 (June) 1937

182 Martin, R, and Delaunay, A. Action of Para-Amino-Phenyl-Sulfamide (Sulfanilamide) in Purulent Meningitis with Streptococci and Accessorily with Meningococci, *Presse med* **45** 1406 (Oct 6) 1937

183 Frazer, M J L. Recovery from Streptococcal Meningitis After Prontosil, *Brit M J* **1** 1023 (May 15) 1937

184 Millet, J. Hemolytic Streptococcus Meningitis. Report of Case with Recovery After Use of Sulfanilamide and Its Derivatives, *New England J Med* **217** 556 (Sept 30) 1937

185 Thompson, C G. Report of Case of Hemolytic Streptococcic Meningitis, with Recovery After Prolonged Use of Prontosil and Prontylin (Sulfanilamide), *J Connecticut M Soc* **1** 363 (Aug) 1937

186 Folsom, T G. Streptococcic Meningitis. Review of a Case Treated Successfully with Sulfanilamide, *West Virginia M J* **34** 33 (Jan) 1938

have each reported a case with recovery. Anderson<sup>187</sup> reported recovery in a case of hemolytic streptococcic meningitis with otitis media and positive cultures of the spinal fluid. Weinberg, Mellon and Shinn<sup>49</sup> reported 2 cases with recovery and Hageman and Blake<sup>137</sup> reported 5 cases, with recovery in 2. Friedman and Lieberman<sup>188</sup> reported post-operative streptococcic meningitis in a case of mastoid involvement with recovery. Mitchell and Trachsler<sup>118</sup> noted that 4 of 7 patients with streptococcic meningitis recovered, but Trachsler and others<sup>174</sup> observed that a patient not treated with sulfanilamide also recovered. Vaisberg<sup>189</sup> reported the recovery of a patient with acute mastoiditis complicated by hemolytic streptococcic meningitis. Godwin<sup>190</sup> reported 2 cases of hemolytic streptococcic meningitis with recovery, and 5 similar cases with recovery were reported by Carey<sup>169</sup>. Hodgins<sup>191</sup> reported a case of streptococcic septicemia with recovery. Kopetzky<sup>192</sup> recently reported that he had obtained better results in the treatment of otogenic meningitis with sulfanilamide than with any other drug, serum or vaccine. Combined with small transfusions he stated, the drug is the best therapeutic agent he has employed. Bernheimer and Cooley<sup>193</sup> successfully treated a patient with streptococcic meningitis with sulfanilamide after exposing the dura of the middle fossa during the mastoidectomy and because of infiltrating thrombophlebitis ligating the internal jugular vein. Smith and others<sup>194</sup> reported the recovery after treatment with sulfanilamide of a patient with meningitis of otitic origin caused by an obligate anaerobic beta hemolytic streptococcus. Oral sulfanilamide therapy was relied on exclusively except for the first two days of the disease, when prontosil soluble was given intramuscularly.

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187 Anderson, E. D. Hemolytic Streptococcus Meningitis. Report of a Case with Recovery After the Use of Prontosil and Sulfanilamide, *J. A. M. A.* **108**: 1591 (May 8) 1937.

188 Friedman, M. D., and Lieberman, L. Severe Hemolytic Streptococcic Meningitis with Recovery After Use of Prontosil and Sulfanilamide, *Ohio State M. J.* **33**:1322 (Dec.) 1937.

189 Vaisberg, M. The Use of Sulfanilamide in Acute Mastoiditis. Report of a Case, *Laryngoscope* **48**:54 (Jan.) 1938.

190 Godwin, D. E. Two Cases of Streptococcus Hemolyticus Meningitis with Recovery Following the Use of Sulfanilamide, *Laryngoscope* **48**:59 (Jan.) 1938.

191 Hodgins, W. S. Case of Streptococcus Septicemia, *Canad. M. A. J.* **37**:174 (Aug.) 1937.

192 Kopetzky, S. J. The Management and Treatment of Otogenic Meningitis, *Ann. Otol., Rhin. & Laryng.* **47**:117 (March) 1938.

193 Bernheimer, L. B., and Cooley, W. Streptococcic Meningitis with Recovery, *Arch. Otolaryng.* **26**:687 (Dec.) 1937.

194 Smith, F. W., and others. Anaerobic Beta Hemolytic Streptococcus Meningitis of Otitic Origin Treated with Sulfanilamide and Culminating in Complete Recovery, *J. A. M. A.* **110**:887 (March 19) 1938.



Kopetzky<sup>192</sup> reported 3 cases of otogenic meningitis due to the hemolytic streptococcus. One patient was subjected to a radical apicectomy before sulfanilamide was given. This patient and 2 with otitic hydrocephalus recovered after adequate surgical measures were followed with sulfanilamide therapy. Galloway<sup>162</sup> reported 5 cases of hemolytic streptococcic meningitis in which recovery followed sulfanilamide therapy, in 2 of these, in which there were definite indications for mastoidectomy, the condition cleared up in a few days. Guttman<sup>162</sup> treated a patient with hemolytic streptococcic meningitis with sulfanilamide, and recovery followed. Woodman<sup>195</sup> noted the recovery of a patient with hemolytic streptococcic meningitis of otogenic origin after surgical drainage, frequent spinal taps and administration of convalescent scarlet fever serum, prontosil soluble and sulfanilamide. Lewy<sup>196</sup> treated 8 patients with otogenic meningitis with sulfanilamide or prontosil. Of 6 with positive cultures of the spinal fluid, 3 died. The 3 fatal attacks were due to the hemolytic streptococcus. One patient showed profound changes in the dura and was moribund when therapy was started, 1 may have died because of the lack of specificity of the drug for alpha hemolytic streptococci, but this patient and the third who died seemed benefited by the drugs and lived longer than the average patient with meningitis. In 1 of the cases in which treatment was successful organisms were demonstrated on smear but not on culture. A Lewy<sup>162</sup> reported the recovery of 4 patients with meningeal extension after mastoiditis when sulfanilamide was given. Smith and Coon<sup>197</sup> reported 2 cases of otogenic meningitis caused by a hemolytic streptococcus in which recovery followed the use of prontosil soluble and sulfanilamide.

Bloch and Pacella<sup>198</sup> reported staphylococcic meningitis in a 17 day old infant who responded favorably to treatment with oral and intrathecal administration of sulfanilamide. Jackson<sup>199</sup> reported recovery in a case of staphylococcic meningitis. Fritz and Hollister<sup>200</sup>

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195 Woodman, DeG. Otitic Meningitis. Report of a Case in Which Treatment Was Followed by Recovery, *Arch Otolaryng* **26** 310 (Sept) 1937

196 Lewy, R. B. The Use of Prontosil and Sulfanilamide in the Treatment of Otogenic Meningitis. Report of Eight Cases, *Ann Otol, Rhin & Laryng* **46** 1096 (Dec) 1937

197 Smith, H. B., and Coon, E. H. Meningitis Due to Hemolytic Streptococcus. Report of Two Cases with Recovery After the Use of Prontosil and Sulfanilamide, *Arch Otolaryng* **26** 56 (July) 1937

198 Bloch, H., and Pacella, B. L. Staphylococcic Meningitis. Report of a Case in a Seventeen Day Old Infant Successfully Treated with Sulfanilamide, *J A M A* **110** 508 (Feb 12) 1938

199 Jackson, R. L. Staphylococcus Aureus Meningitis. Report of Case with Recovery, *J Pediat* **11** 518 (Oct) 1937

200 Fritz, M., and Hollister, W. Meningitis Due to Staphylococcus Aureus Haemolyticus. Report of a Recovery, *Arch Otolaryng* **27** 317 (March) 1938

treated a patient with otogenic meningitis due to *Staph aureus* haemolyticus with staphylococcus antitoxin, blood transfusions and prontosil soluble administered intramuscularly. Recovery occurred, but because of toxic neuritis of both eighth nerves there was complete loss of hearing. In general, there is not much evidence that sulfanilamide offers possibilities of coping with staphylococcic infections. The original prontosil has been noted to have some chemotherapeutic effect, however, in various staphylococcic infections by Schianz,<sup>21</sup> Anselm,<sup>17c</sup> Schieus,<sup>17b</sup> Tonndorf,<sup>201</sup> Meyer zu Horste<sup>202</sup> and Jaeger<sup>203</sup>. Imhauser<sup>18</sup> reported failure in treating septic conditions in 2 cases, in 1 of which the patient died from meningitis as the result of intracranial foci. Colebrook and Purdie,<sup>130</sup> however, were able to cure 2 of 3 patients with puerperal staphylococcic septicemia. Basman and Peirley<sup>104</sup> reported 2 patients with staphylococcic septicemia dying in spite of sulfanilamide therapy.

*Pneumococcic Meningitis*—That sulfanilamide is a potent therapeutic agent in experimental pneumococcic infections in animals has been shown by numerous investigators,<sup>201</sup> but the application of the drug to infections in man has not been widespread. Heintzelman, Hadley and Mellon<sup>205</sup> reported 19 cases of type III pneumonia, in which 9 of the patients were treated with sulfanilamide and 10 received no special form of treatment. The drug was administered orally. Seven of 9 treated with the drug recovered and 2 died. Of the 10 untreated patients, 2 recovered and 8 died. In a group of 33 cases not under their direct observation 9 patients recovered and 24 died when the drug was given. The mortality for all patients not treated with sulfanilamide was 74 per cent, that for the treated patients, 22 per cent. Millett<sup>206</sup> reported that the recovery of a patient with type III pneumonia was due to sulfanilamide therapy. Waring and Rettberg<sup>159</sup> obtained poor clinical results in all types of pneumonia, and 1 patient with type V pneumococcic lobar pneumonia died.

Neal and Appelbaum<sup>171</sup> used sulfanilamide in 14 cases of pneumococcic meningitis, 3 patients recovered and 11 died. The fifteenth had

201 Tonndorf, E. Eine luckenlose Reihe von Erysipelheilungen durch Prontosil, *Med Klin* **32** 1307 (Sept 18) 1936

202 Meyer zu Horste, G. Zur Prontosilbehandlung, *Klin Wchnsch* **15** 1602 (Oct 31) 1936

203 Jaeger, K. H. Ueber otische Prontosilanwendung, *Deutsche med Wchnschr* **62** 1831 (Nov 6) 1936

204 Domagk<sup>84</sup> Cooper, Gross and Mellon<sup>40</sup> Hoerlein<sup>85a</sup> Colebrook and Kenny<sup>77a</sup> Rosenthal<sup>86a</sup> Rosenthal, Bauer and Branham<sup>45</sup> Nitti, Bovet and Depierre<sup>87</sup> Buttle, Parish, McLeod and Stephenson<sup>98</sup>

205 Heintzelman, J. H. L., Hadley, P. B., and Mellon, R. R. The Use of *p*-Amino-Benzenesulfonamide in Type III *Pneumococcus* Pneumonia, *Am J M Sc* **193** 759 (June) 1937

206 Millett, J. Sulfanilamide. Report of a Case, *New York State J Med* **37** 1743 (Oct 15) 1937

meningitis caused by a mixed infection with *Pneumococcus* type III and *Str. viridans* and died in spite of sulfanilamide therapy. Waing and Rettberg<sup>159</sup> reported 2 deaths from pneumococcic meningitis and 2 deaths from pneumococcic septicemia, although all patients received adequate doses of the drug. Mertins and Mertins<sup>207</sup> reported recovery after treatment with sulfanilamide in a case of unclassified type IV pneumococcic meningitis of otitic origin. Bassman and Perley<sup>104</sup> reported the recovery of a patient with otogenic meningitis caused by infection with type V pneumococci after treatment with sulfanilamide, and the death of a patient with otogenic meningitis caused by infection with type III pneumococci, probably because of inadequate doses. Mitchell and Trachsler<sup>118</sup> reported the recovery of a patient with meningitis caused by infection with type V pneumococci but since ethylhydrocupreine hydrochloride had also been used, he attributed the favorable outcome to that drug rather than to sulfanilamide. Kopetzky<sup>192</sup> described the recovery of a patient with otogenic meningitis due to *Pneumococcus* type III by means of the removal of a residual bony focus in the zygomatic root of the temporal bone, repeated small transfusions and daily administration of sulfanilamide by mouth.

*Other Types of Meningitis*—Basman and Perley<sup>104</sup> were able to culture *Bacillus proteus* from the spinal fluid and blood of a child with otogenic meningitis. Sulfanilamide was used intrathecally, intramuscularly and orally. Improvement was noted for three days, during which time cultures of the blood and the spinal fluid were negative. The child was worse on the fourth day, and operation on the fifth day revealed a coalescent type of mastoiditis, with cells filled with pus, granulation tissue and debris. Postoperative recovery was uneventful.

McIntosh and others<sup>117</sup> reported 2 cases of meningitis due to *H. influenzae* in which both the patients died. One patient, whose condition was of otogenic origin, had hemolytic streptococci in the mastoid wound, and *H. influenzae* was obtained on culture of the blood. Administration of sulfanilamide was started one week after mastoidectomy, but there was no effect on either the hemolytic streptococci or the influenza bacilli. McQuarrie<sup>208</sup> noted improvement in a case of meningitis due to *H. influenzae* in which both influenza serum and sulfanilamide were given, but after two weeks the patient became progressively worse and died. Hageman<sup>132</sup> treated a patient with influenzal meningitis with sulfanilamide, but the disease ran its natural course and terminated fatally. Basman and Perley<sup>104</sup> were unable to alter

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207 Mertins, P. S., and Mertins, P. S., Jr. Meningitis Due to Type IV *Pneumococcus*, with Recovery. Report of a Case, *Arch. Otolaryng.* **25** 657 (June) 1937.

208 McQuarrie, I. Report of Cases Treated with Sulfanilamide (Prontosil and Prontylin), *J. Pediat.* **11** 188 (Aug.) 1937.

the course of otogenic meningitis due to *H. influenzae* with sulfanilamide in 1 case, and the patient died. There is, as yet, little clinical evidence that the drug is of value in influenzal meningitis, but Neal and Appelbaum<sup>171</sup> have reported the recovery of a patient with influenzal meningitis treated with anti-influenzal serum and sulfanilamide. They again emphasized that whenever meningitis is secondary to a focus of infection it is important to eradicate this focus as completely and as promptly as possible.

*Meningococcic Meningitis*—Buttle and others<sup>39a</sup> and Proom<sup>74</sup> demonstrated the protective and curative properties of the drug against meningococcic infections in mice. Schwentker, Gelman and Long<sup>145</sup> reported 10 cases of meningococcic meningitis and 1 of septicemia in which sulfanilamide was administered intraspinally and subcutaneously; there was 1 death, of pneumonia on the fifth day, although the spinal fluid was sterile for three days and the cell count was only 158 on the day of death. In some cases, the cell count of the spinal fluid fell rapidly and progressively. In other cases, the count remained elevated for several days and then decreased precipitously. Cultures of the spinal fluid were sterile after the first treatment in a number of cases, and in no instance was the organism recovered later than three days after treatment was begun. Transient arthritis developed in 2 patients. When given subcutaneously, the solution was absorbed and gave rise to no more tenderness or reaction at the site of injection than does physiologic solution of sodium chloride when similarly administered. No signs of local or systemic reaction followed intrathecal injection. The response to treatment was good in every case and seemed comparable to that produced by the specific antiserum. One definite value of the drug over antimeningococcus serum was the absence of any irritation due to foreign protein. McIntosh<sup>117</sup> treated 2 patients with meningococcic meningitis and bacteremia with specific antiserum and sulfanilamide, and both recovered. Mitchell and Trachsler<sup>118</sup> reported the recovery of 3 patients with meningococcic meningitis given combined therapy with antiserum, antitoxin and sulfanilamide administered intraspinally and by mouth. Bernstein<sup>170</sup> and Basman and Perley<sup>104</sup> have each reported 2 cases with recovery. Carey<sup>109</sup> treated 5 patients, 3 of whom had positive cultures of the blood, with the drug alone, and all recovered. Branham<sup>209</sup> reported on the comparative efficacy of serum, antitoxin and drugs in the treatment of meningococcic meningitis. Brennemann<sup>157</sup> was uncertain as to the value of the drug in a case in which the patient recovered but antitoxin also had been used. Willien<sup>210</sup> in 5 cases of meningococcic meningitis found the response satis-

209 Branham, S. E. Serum, Antitoxin and Drugs in Treatment of Meningococcic Meningitis, *M. Ann. District of Columbia* **7** 1 (Jan.) 1938.

210 Willien, L. J. Sulfanilamide Therapy in Meningococcic Meningitis, *J. A. M. A.* **110** 630 (Feb. 26) 1938.

factory when sulfanilamide alone was administered orally. He pointed out that the possibility of a cure in such cases by oral administration alone is of great practical importance in eliminating the time, trouble and expense of intraspinal and intravenous therapy, the danger of protein shock and the discomfort of serum sickness. He expressed the opinion that \$2 worth of the drug might do the work of \$500 worth of serum and do it better. Since the drug is bacteriostatic rather than bactericidal, it is important to continue its administration in reduced doses for ten days to two weeks after the symptoms subside and thus prevent recurrences. Arman-Delille and Weill-Halle<sup>211</sup> expressed the belief that the drug is just as effective when given by mouth as when administered parenterally. Two patients with meningitis promptly recovered when treated with sulfanilamide after no improvement had been obtained with polyvalent antimeningococcus serum. Zendel and Greenberg<sup>212</sup> reported 2 cases of meningococcemia in which cures were brought about by the drug. One of the patients, ill with a high fever for seven weeks, who had had three episodes of meningitis and had been treated with large amounts of meningococcic antitoxin and antiserum intravenously, intramuscularly and intrathecally without effect on the infection of the blood stream, had become extremely sensitive to both antitoxin and antiserum. The prompt recovery after treatment with sulfanilamide was striking. Brown, Bannick and Haben<sup>213</sup> have discussed the use of the drug in meningococcic infections and concurred in describing its efficacy.

*Abscess of the Brain*—Basman and Perley<sup>104</sup> reported 2 cases of otitic abscess of the brain (in 1 caused by infection with the type III pneumococcus and in 1 by infection with a nonhemolytic streptococcus) with recovery after sulfanilamide therapy.

*Cavernous Sinus Thrombosis*—MacNeal and Cavallo<sup>214</sup> reported the recovery of a patient presenting roentgenologic evidence of pansinusitis, with positive cultures of the blood for hemolytic streptococci, severe cyanosis of the face, engorgement of the veins of the forehead and eyelids, marked chemosis of the conjunctivas, including the right cornea, and proptosis on both sides. While the recovery of the patient was the principal evidence against the diagnosis, the clinical picture was that of cavernous sinus thrombosis.

211 Chemotherapy of Cerebrospinal Meningitis, Foreign Letter (Paris), J A M A **110** 297 (Jan 22) 1938

212 Zendel, J F, and Greenberg, D. Meningococcemia. Report of Two Cases, New York State J Med **37** 1744 (Oct 15) 1937

213 Brown, A E, Bannick, E G, and Haben, H C. The Use of Sulfanilamide and Prontosil Solution, Minnesota Med **20** 691 (Nov) 1937

214 MacNeal, W J, and Cavallo, M E. Streptococcic Bacteremia and Apparent Thrombosis of the Cavernous Sinuses with Recovery, J A M A **109** 2139 (Dec 25) 1937

*Bacteremia*—Sulfanilamide appears to be strikingly effective against the types of bacteremia due to the beta hemolytic streptococcus, the meningococcus and, to some extent, the pneumococcus. It is ineffective against *St. viridans* and the staphylococcus. Keefe<sup>215</sup> reported 9 cases of hemolytic streptococcal infection with bacteremia, and 8 cases of hemolytic streptococcal infection without bacteremia. All the patients were treated with sulfanilamide. Three died, of whom 1 was comatose and had polyarthritis when treatment was begun, 1 had bronchopneumonia and empyema and another had thrombophlebitis of the right internal jugular vein and submaxillary abscess.

*Erysipelas*—The effectiveness of the original prontosil in the treatment of erysipelas was reported in 1935.<sup>216</sup> Similar good results obtained with sulfanilamide and its derivatives have since been reported by various authors.<sup>217</sup> Breen and Taylor<sup>218</sup> used sulfanilamide in 35 cases of erysipelas and were particularly impressed with the results for patients between the ages of 50 and 65. Marzollo<sup>219</sup> administered sulfanilamide to 26 patients, including infants and children, suffering from acute erysipelas. The fever abated and leukocytosis diminished during the first or second day or rarely during the third or fourth day. In 88 per cent of the cases, fever disappeared by crisis and the cutaneous symptom improved as soon as the fever abated. Snodgrass and Anderson<sup>220</sup> found the action of sulfanilamide not to be dramatic but stated

215 Keefe, C. S. Hemolytic Streptococcus Infections, with Especial Reference to Prognosis and Treatment with Sulfanilamide, *New England J. Med.* **218** 1 (Jan. 6) 1938.

216 Gmelin, L. Zur Chemotherapie des Erysipels im Kindesalter, *München med. Wchnschr.* **82** 221 (Feb. 7) 1935. Lampert, J. Prontosil gegen Erysipel, *Zentralbl. f. Chir.* **62** 2947 (Dec. 14) 1935. Klee and Romer<sup>17a</sup>. Schreus<sup>17b</sup>. Imhauser<sup>18</sup>. Roth<sup>23</sup>.

217 (a) Scheurer, O. Unsere Erfahrungen mit Prontosil, *Med. Klin.* **32** 739 (May 29) 1936. (b) Valerio, A. Correspondance, *Presse med.* **44** 1317 (Aug. 15) 1936. (c) Frankl, J. Ueber den Wert des Prontosil in der Therapie des Erysipels, *Klin. Wchnschr.* **15** 1563 (Oct. 24) 1936. (d) Anghelescu, V., Crivetz, D., Pascal, I., and Lazarescu, V. Vergleichende Untersuchungen über Serotherapie, ultraviolette Bestrahlung und Chemotherapie des Erysipels, *Deutsche med. Wchnschr.* **62** 1639 (Oct. 2) 1936. (e) Becker, W. Die Behandlung des Erysipels mit Prontosil, *Dermat. Wchnschr.* **104** 221 (Feb. 13) 1937. (f) Kramer<sup>26</sup>. (g) Meyer-Heine and Huguenin<sup>33</sup>. (h) Bloch-Michel, Conte and Durel<sup>34</sup>. (i) Peters and Havard<sup>81g</sup>. (j) Tonndorf<sup>201</sup>. (k) Meyer zu Horste<sup>202</sup>.

218 Breen, G. E., and Taylor, I. Erysipelas Treated with Prontosil, *Lancet* **1** 1334 (June 5) 1937.

219 Marzollo, E. Contributo allo studio della terapia dell'eresipela con i composti azoici, *Gior. veneto di sc. med.* **11** 340 (June) 1937.

220 Snodgrass, W. R., and Anderson, T. Prontosil in Treatment of Erysipelas. Controlled Series of Three Hundred and Twelve Cases, *Brit. M. J.* **2**. 101 (July 17) 1937.

that the patients on whom it was employed showed better results than those treated with ultraviolet radiation or scarlet fever antitoxin. These authors later<sup>221</sup> found that the administration of the drug reduced the incidence of complications and diminished the tendency to recurrence. Fever was rare after forty-eight hours of sulfanilamide therapy, and the lesions failed to spread after the same period. Scherber,<sup>222</sup> Frankl<sup>217c</sup> and Kramer<sup>26</sup> found that the rapid alteration in the clinical course of erysipelas was easier to explain on the basis of neutralization of toxin than on the basis of bactericidal action. Basman and Perley<sup>104</sup> stated that some of their most satisfactory results with sulfanilamide were obtained in cases of erysipelas. They encountered 4 instances of the formation of abscess in their 9 patients. In 1 case, the erysipelas followed antrotomy. Hageman and Blake<sup>137</sup> reported 27 patients with erysipelas treated with sulfanilamide. The duration of the disease in the control group was 13.9 days, as compared to 5.3 days in the group treated with sulfanilamide. Spread of the local lesions was noted in 66 per cent of the control series, while only 11 per cent of those treated showed more than slight marginal spread. Two infants with erysipelas and positive cultures of the blood recovered when treated with sulfanilamide. Watson-Williams<sup>158</sup> obtained good results in 70 cases of erysipelas, bringing about recovery without a single death.

*Infection of a Wound*—Some interest attaches to the report of Purdie<sup>223</sup> of a case of chronic infection of a wound due to a hemolytic streptococcus, following puerperal sepsis due to the same organism three years previously. Various operative procedures and actinotherapy had failed to give relief. Oral administration of sulfanilamide and local treatment with the drug sterilized the wound and resulted in complete healing.

*Infections of the Sinuses*—There is a singular paucity of reports concerning the effects of sulfanilamide on infections of the sinuses. Watson-Williams<sup>158</sup> reported the drug to be efficacious in treating acute infections of the paranasal sinuses. McIntosh<sup>117</sup> used sulfanilamide in 2 cases of maxillary sinusitis due to the hemolytic streptococcus. In 1 case the drug was given after drainage of both antrums because maxillary and ethmoid sinusitis had been present for six months, but the

221 Snodgrass, W. R., and Anderson, T. Sulfanilamide in Treatment of Erysipelas. Controlled Series of Two Hundred and Seventy Cases, *Brit. M. J.* **2**: 1156 (Dec. 11) 1937.

222 Scherber, G. Zur lokalen und allgemeinen Behandlung des Rotlauf, in letzterer Beziehung mit besonderer Darstellung der Anwendung des Farbstoffpräparates Prontosil (Streptozon, Präparat 5214) wie der Behandlungsergebnisse mit Omnadin, *Wien. med. Wchnschr.* **85**: 284 (March 9), 346 (March 23), 376 (March 30) 1935.

223 Purdie, A. W., and Fry, R. M. Chronic Haemolytic Streptococcal Infection Treated with *p*-Aminobenzenesulphonamide, *Lancet* **2**: 18 (July 3) 1937.

effects of the drug were questionable. In the other case the patient with bilateral maxillary sinusitis and recurrent pneumonia of six weeks duration, was treated conservatively for five weeks. Sulfanilamide was then given for two weeks, and no recurrence of fever followed. Favorable results were also obtained with sulfanilamide in a case of ethmoid sinusitis with orbital cellulitis. Mitchell and Trachsler<sup>115</sup> said that sinusitis was apparently favorably affected by sulfanilamide therapy. Hageman<sup>132</sup> found sinusitis to respond favorably in 4 cases without surgical intervention when the drug was used.

*Use of Sulfanilamide in Other Diseases*—Swift, Moen and Hirst<sup>224</sup> concluded that the toxic action of sulfanilamide in cases of active rheumatic fever so far outweighed the beneficial therapeutic effect that its administration to patients with this disease did not seem justified. Recknagel<sup>19</sup> and McQuarrie<sup>208</sup> however noted some improvement in cases of acute rheumatic fever. Basman and Perley<sup>102</sup> had inconclusive results in 2 cases of rheumatic fever. Brown and Bannick<sup>225</sup> reported that sulfanilamide had failed in a case of tularemia but had hastened the recovery in a case of acute infectious mononucleosis. McQuarrie<sup>208</sup> obtained no results with sulfanilamide in 2 cases of lymphatic leukemia. McIntosh and others<sup>117</sup> were also unable to demonstrate any beneficial effect of the drug in acute lymphatic leukemia. Bohlman<sup>226</sup> reported 3 cases of post-traumatic gas gangrene, in each of which the condition was associated with compound fractures of the leg or thigh. While the dramatic result in these cases was thought to be due to a specific effect on the gas bacillus it was admittedly possible that the outcome was due in part to the checking of symbiotic growth with the streptococcus or other aerobes. In 1 case the temperature became normal and no toxic symptoms appeared eighteen hours after the first dose of sulfanilamide. All 3 patients had received gas gangrene antitoxin without appreciable effect but Ghormley's contributions<sup>227</sup> on the general value of prophylactic antitoxin cannot as yet be discarded. Bohlman suggested that in all cases involving severe crushing injuries in which streptococci or gas bacilli may subsequently appear a combination of antitoxin and sulfanilamide may present the greatest advance in the prevention of gas gangrene infection.

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224 Swift, H. F., Moen, J. K., and Hirst, G. K. The Action of Sulfanilamide in Rheumatic Fever. *J. A. M. A.* **110**: 426 (Feb. 5) 1938.

225 Brown, A. E. and Bannick, E. G. The Use of Sulfanilamide and Prontosil Solution, *Proc. Staff Meet. Mayo Clin.* **12**: 644 (Oct. 13) 1937.

226 Bohlman, H. R. Gas Gangrene Treated with Sulfanilamide. *J. A. M. A.* **109**: 254 (July 24) 1937.

227 Ghormley, R. K. Gas Gangrene and Gas Infections. *J. Bone & Joint Surg.* **17**: 907 (Oct.) 1935.



# MORPHOLOGIC AND ROENTGENOLOGIC ASPECTS OF THE TEMPORAL BONE

STUDY OF 536 BONES WITH SPECIAL REFERENCE  
TO PNEUMATIZATION

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*(Concluded from page 580)*

## CLASSIFICATION OF ADULT MATERIAL

Four examples from the previous section have been selected to represent phases of normal pneumatization. The word phase is used in contradistinction to such a term as stage because it is intended to imply absence of strictly delimiting boundaries. Figure 4 *B* shows the picture at birth, representatives of this phase will henceforth be referred to as group I. Figure 5 *B* shows the normal development one finds at the approximate age of 2 years, representatives of this phase will be referred to as group II. Figure 5 *F* reveals the phase which has extensive pneumatization except in the apex of the pyramid, where there is none, representatives of this phase will hereafter be called group III. Complete pneumatization of the pyramid (cells in the apex) is shown in figure 6 *F*, representatives of this phase show no arrest and henceforth will be group IV.

As an illustration of the method of classification, observe figure 7 *A*. Specimen 1439 R, a bone of a 57 year old white man. By comparison with figure 4 *B*, it is noted that pneumatization has been arrested at birth or even before, thus this bone is classified in group I. Specimen 1726 R (fig 7 *B*) is that of another 57 year old white man. By comparison with figure 5 *B*, it is seen to show pneumatization which was arrested near the 2 year phase, and is therefore classified in group II. Specimen 1460 R (fig 7 *C*) is that of a 61 year old man and shows no pneumatization in the apex when compared with figure 5 *F* but is otherwise extensively pneumatized, thus going into group III. Figure 7 *D* is the left side of the specimen 1439, referred to previously in this paragraph, and by comparison with figure 6 *F* shows widespread pneumatization including the apex (no arrest) and is classified in group IV.

Since groups I and II have arrested pneumatization (complete and partial) and groups III and IV show little if any arrest of pneumatiza-

tion (slight arrest and no arrest), I and II would be expected to have many morphologic features in common, especially if the apical or carotid part of the pyramid is not included. In group IV there are bones showing a small amount of pneumatization in the apex and bones which show complete pneumatization of the apex. The morphologic features and mensural data on each temporal bone were recorded before roentgenograms were made.

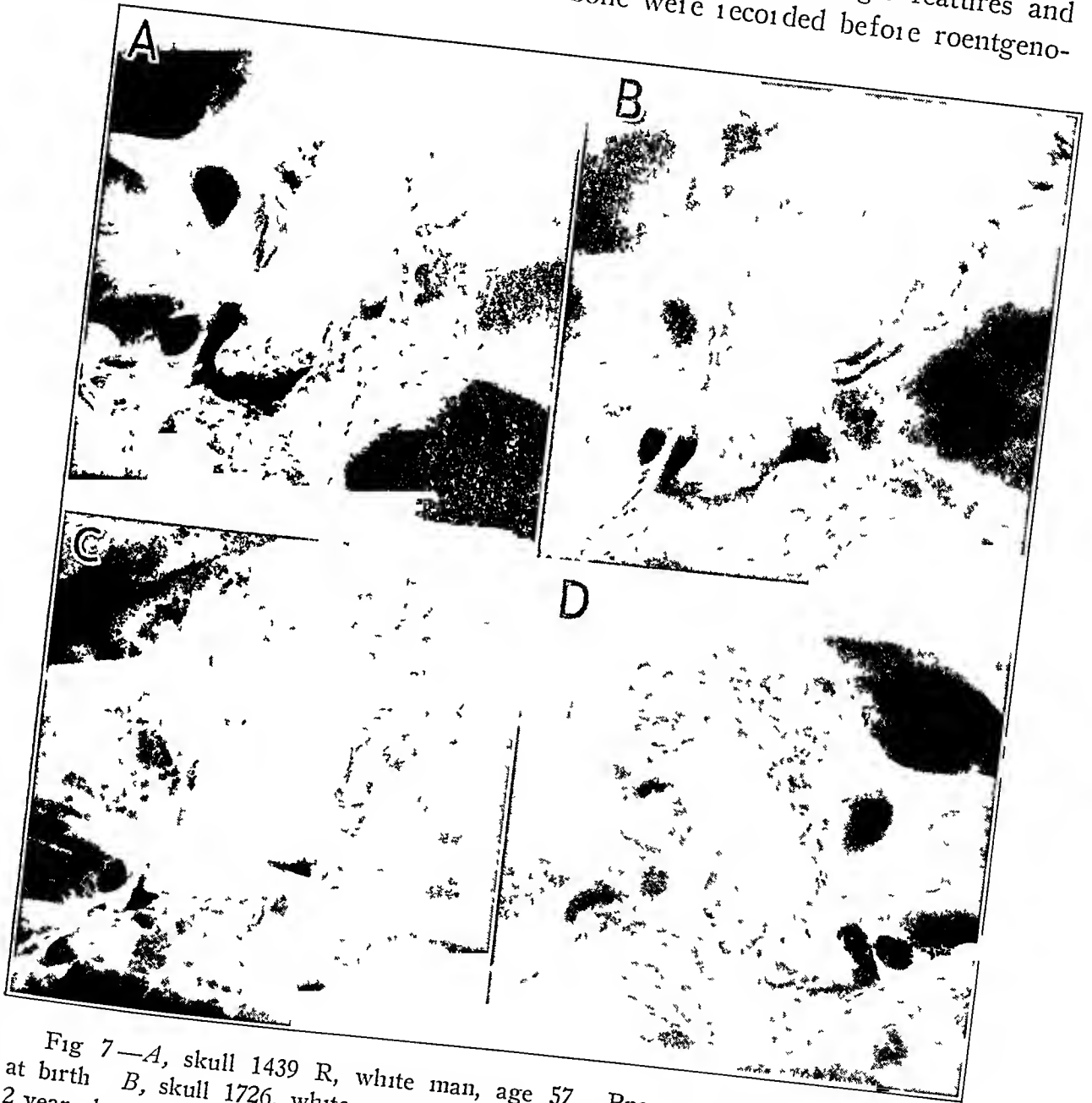


Fig 7—A, skull 1439 R, white man, age 57. Pneumatization was arrested at birth. B, skull 1726, white man, age 57. Pneumatization was arrested in the 2 year phase. C, skull 1460, white man, age 61. There is extensive pneumatization except in apex or carotid part of the pyramid. D, skull 1439 L, white man, age 57 (fig 7 A). Pneumatization is complete.

Accordingly, the data represent an unprejudiced measurement, because at the time of recording them it was not known in which group a bone would finally be classified.

The total anatomic material used in this study comprises the following series of temporal bones

69 skulls, 1 e, 138 bones, ranging in maturation age from 7 fetal months to 15 years These show no distinguishing sexual or racial characters They were used in the process of building the standard of development

39 skulls, 1 e, 78 bones, of chronologic age 16 to 20 These also show no distinguishing racial or sexual characters

50 skulls, 1 e, 100 temporal bones, of white men, chronologic age 20 to 30

50 skulls, 1 e, 100 temporal bones, of Negro men, chronologic age 20 to 30

50 skulls, 1 e, 100 temporal bones, of white men, chronologic age 55 to 65

TABLE 1—*Skeletal Numbers of 100 Temporal Bones of 55 to 65 Year Old White Men Classified into Groups I to IV\**

I	II		III	IV
1489 R	1726 R & L	899 R	1206 R & L	1489 L
1280 R & L	1588 R & L	1943 R & L	1210 R & L	1488 R & L
1770 R & L	554 L	996 R & L	1872 R & L	1553 R & L
1236 R & L	1019 L	621 R & L	1594 R & L	1026 R
1061 R & L	1669 R & L	869 R & L	1011 R & L	1458 R & L
1347 R & L	1564 R & L	1591 R & L	1741 R & L	1382 R & L
554 R	1033 R & L	1058 R & L	1570 R & L	995 R & L
1019 R	991 R	912 R & L	1217 R & L	1203 R & L
899 L	1486 R & L	923 R & L	797 R & L	1685 R & L
991 L	1764 R & L	1745 R & L	1255 R & L	1472 R & L
				1167 R & L

\* R = right, L = left—indicating individual temporal bones

In addition, 20 temporal bones were studied before and after maceration, therefore, the aggregate is 536 temporal bones

The series of specimens of 55 to 65 year old white men definitely represents a stage at which no further development of pneumatization need have been expected in those particular temporal bones, it may be said that in examining them one is examining the final result The bones falling into groups I, II, III and IV, according to the roentgenologic classification herein developed, were tabulated separately (table 1), and for each group the measurements and features A, B, C through L were listed (tables 2, 3, 4 and 5) These measurements and features have already been defined In this series of 100 bones of 55 to 65 year old white men, 15 show arrest at birth, 56 show arrest at or near the 2 year period of development, 21 show arrest only in the sense that no cells were formed in the apex, and 8 show complete pneumatization

(cells in apex). It is interesting to observe that in specimen 1439 the right side shows arrest at birth and the left side no arrest at all (fig. 7 *A* and *D*). This is an excellent example of the wide differences which may be found on the two sides of one skull. Seventy-one namely the total number included in groups I and II show arrest from some factor in early life, of the 29 i e groups III and IV together, which escaped this factor in early life only 8 bones show complete freedom from arrest somewhere in life.

In considering each of the four groups in this series one should refer to tables 2, 3, 4 and 5. In group I (arrest at birth) the distance (A) between the depression of Wilde and the arcuate eminence averages

TABLE 2—Group I from Table 1, with Individual Data Listed \*

Specimen	A	B	C	D	E	F	G	H	I	J	K	L
1439 R	23.0	32.0	3.5	10.0	14.0	15.0	16.0	18.0	40 × 11.0	35	High O	14.0
1250 R	24.0	32.5	3.5	7.0	11.0	9.5	11.0	17.0	16.0 × 6.0	50	High O	13.0
1250 L	23.0	33.0	4.5	6.0	12.0	8.5	16.0	20.0	10.0 × 6.0	45	High O	10.0
1770 R	24.0	33.0	4.0	9.5	16.0	13.0	22.0	19.0	3.0 × 15.0	35	Low —	17.0
1770 L	22.0	32.0	4.0	9.5	15.0	11.0	19.0	15.5	5.0 × 14.0	40	Medium O	11.0
1258 R	23.0	30.0	5.0	8.0	14.5	12.5	23.0	22.0	4.0 × 10.0	40	Low —	12.0
1258 L	23.0	30.5	4.0	8.0	13.5	12.0	23.5	19.0	5.0 × 12.0	30	High O	7.0
1061 R	22.0	32.5	2.0	6.0	15.5	13.0	17.0	22.0	4.0 × 11.0	35	Medium O	14.0
1061 L	28.0	31.5	3.0	7.0	15.5	13.0	15.0	21.0	13.0 × 3.0	20	High O	11.0
1347 R	24.0	34.0	3.0	8.5	13.0	11.5	16.0	16.0	5.0 × 15.0	40	High O	12.0
1347 L	24.0	34.0	5.0	8.0	14.5	12.0	15.0	15.0	5.0 × 11.0	20	High O	11.0
554 R	20.0	30.0	3.0	7.5	9.5	9.5	17.0	21.0	5.0 × 7.5	20	High O	11.0
1019 R	21.0	33.5	2.5	6.0	10.5	13.0	19.0	19.0	5.0 × 15.0	20	Medium —	11.0
829 L	24.0	31.5	3.5	7.5	12.0	13.5	16.0	19.0	16.0 × 7.0	30	High O	7.0
921 L	22.0	34.5	4.0	6.5	12.0	13.0	13.0	21.0	5.0 × 15.5	55	High O	11.0
Maximum	30.0	39.0	5.0	10.0	16.0	15.0	23.5	22.0				17.0
Minimum	21.0	30.0	2.0	6.0	9.5	8.5	11.0	15.5				7.0
Average	24.0	33.0	3.6	7.7	12.5	12.0	17.2	19.2				11.5

\* All measurements are recorded in millimeters. Any angle listed in column I as 20 degrees measured 20 degrees or less. The sign O is used in column K to indicate roundness of the jugular fossa and the sign — to indicate flatness.

24.0 mm (15 bones) and ranges from 21.0 to 30.0 mm. In group II the same distance averages 23.7 mm and ranges from 20.0 to 27.0 mm. In group III the average (A) is 25.8 mm and the range from 22.5 to 29.0 mm. Group IV, which shows no arrest, has an average of 26.2 mm and a range from 24.0 to 28 mm. From this comparison it is noticed that the distance between the two landmarks under consideration is less in groups I and II which show arrest in early life than in groups III and IV, which escape arrest in early life.

For the distance (B) between the arcuate eminence and the medial tip of the apex of the pyramid the average of group I is 33.0 mm, group II 33.3 mm, group III 34.3 mm and group IV 32.8 mm. The maximum and minimum measurements can be found in the tables. For the sake of brevity, only the averages will be considered, among which

TABLE 3—Group II from Table 1, with Individual Data Listed \*

Specimen	A	B	C	D	E	F	G	H	I	J	K	L
1588 R	23 0	30 0	2 0	6 5	11 0	12 5	13 0	21 5	6 0 × 12 0	45	High ○	14 0
1588 L	23 0	32 5	2 0	6 0	12 5	12 0	14 0	21 0	13 5 × 6 0	55	High ○	13 0
1726 R	23 0	32 5	3 0	8 0	12 0	9 0	20 0	16 0	4 0 × 12 0	55	Low —	11 0
1726 L	22 0	37 5	3 5	6 5	12 0	10 0	16 0	13 0	6 0 × 13 0	60	High ○	13 0
554 L	26 0	34 0	3 0	7 5	9 5	9 5	14 0	17 0	5 0 × 13 5	45	High ○	12 0
1019 L	23 0	32 5	3 0	6 5	11 0	11 0	20 0	20 0	3 0 × 15 5	20	Medium —	14 0
1669 R	21 0	34 0	2 5	6 0	12 5	13 5	17 0	20 0	14 0 × 5 0	50	High ○	14 0
1669 L	23 0	36 5	3 5	6 5	12 0	9 5	17 0	17 5	12 5 × 5 0	45	High ○	12 5
1564 R	23 0	33 0	3 0	9 0	13 0	10 0	21 0	17 0	5 0 × 16 0	50	Medium ○	13 5
1564 L	23 0	30 0	3 5	9 0	12 0	9 5	18 0	17 5	15 5 × 4 0	40	Medium —	14 0
1033 R	24 0	32 0	3 5	7 5	14 0	12 0	22 0	18 0	2 0 × 10 0	35	Low —	10 0
1033 L	26 0	32 0	3 0	9 0	15 0	13 0	20 0	17 0	4 0 × 11 0	60	Low —	10 0
991 R	21 0	35 0	4 0	8 0	12 5	14 0	15 0	18 0	5 0 × 13 0	40	High ○	15 0
1486 R	24 0	36 0	3 5	9 5	15 0	13 5	21 0	18 5	3 0 × 3 0	40	Medium —	19 0
1486 L	25 0	32 5	3 0	9 5	15 0	14 0	22 5	18 0	1 0 × 6 0	45	Low —	21 0
1764 R	20 0	26 0	3 5	7 5	12 5	11 0	15 0	18 5	5 0 × 7 0	35	High ○	12 0
1764 L	23 0	32 0	3 0	6 0	13 5	10 0	21 5	17 0	15 0 × 6 0	40	Low —	14 0
899 R	22 0	32 5	2 5	8 0	11 5	16 5	15 5	20 0	6 0 × 17 0	30	High ○	11 0
1943 R	22 0	35 0	2 0	9 0	13 5	10 0	17 0	18 0	5 5 × 20 0	40	High ○	11 0
1943 L	23 0	32 0	2 0	9 0	14 0	10 5	21 0	22 0	18 0 × 6 0	50	Low —	12 0
996 R	26 0	30 5	5 0	7 5	15 0	12 0	22 5	22 0	6 0 × 13 5	25	Low —	17 0
996 L	26 5	29 0	4 0	9 0	15 0	13 0	19 0	21 0	4 0 × 13 0	40	High ○	15 0
621 R	22 0	32 0	1 5	7 0	14 0	12 5	16 0	19 0	5 0 × 14 0	55	High ○	12 0
621 L	24 0	32 0	2 0	7 5	15 5	14 0	15 0	18 0	6 0 × 15 0	45	High ○	16 0
869 R	21 0	31 5	2 0	7 0	15 0	11 0	17 0	16 5	4 0 × 13 0	40	High ○	13 0
869 L	25 0	33 0	3 0	6 5	14 5	12 0	17 0	19 0	3 0 × 8 0	40	High ○	15 5
1591 R	24 0	36 0	3 5	7 5	15 0	14 5	19 0	19 0	5 0 × 21 0	25	High ○	15 0
1591 L	24 0	32 5	3 5	9 0	12 0	13 5	14 0	16 0	4 0 × 20 0	40	High ○	12 0
1058 R	26 0	30 5	3 0	8 0	14 5	10 0	19 0	17 0	12 5 × 4 0	25	Medium —	12 0
1058 L	26 0	29 0	4 0	8 0	15 5	10 0	23 5	20 0	11 5 × 4 0	30	Low —	12 0
912 R	27 0	36 0	6 0	6 0	13 5	12 0	15 0	20 0	5 0 × 10 0	25	High ○	11 0
912 L	26 0	34 0	6 0	6 5	13 0	13 0	19 5	19 5	5 0 × 6 0	35	Low —	9 0
923 R	26 0	32 5	2 5	8 5	11 5	19 0	20 5	22 5	5 0 × 10 0	40	High —	21 0
923 L	26 0	31 0	3 5	8 5	13 0	14 0	17 0	21 0	4 0 × 12 0	45	Medium ○	19 0
1745 R	23 0	38 0	5 0	7 5	14 0	13 0	17 0	14 0	5 0 × 17 0	45	Medium ○	16 5
1745 L	26 0	35 0	4 5	6 5	13 0	13 5	22 0	16 0	3 0 × 11 0	45	Low —	19 0
1206 R	24 0	33 0	3 0	7 0	14 0	14 0	14 0	19 0	5 0 × 14 0	55	High ○	20 0
1206 L	24 5	34 0	3 0	7 5	15 0	16 0	20 0	18 0	6 0 × 10 0	50	Low —	15 0
1210 R	23 0	38 0	3 0	7 0	13 5	11 0	21 0	16 0	5 0 × 17 0	30	Medium —	11 0
1210 L	23 0	37 0	2 5	7 0	15 0	12 5	23 5	20 0	5 0 × 9 0	40	Low —	11 0
1872 R	22 5	32 0	4 0	8 5	11 0	15 5	12 0	17 5	3 0 × 4 0	50	High ○	14 0
1872 L	24 0	36 5	3 0	7 0	11 5	12 5	19 0	18 5	5 0 × 8 0	40	Low —	10 0
1594 R	25 0	33 0	2 5	7 0	12 0	13 5	14 0	19 0	4 0 × 9 0	40	High ○	15 0
1594 L	26 0	33 0	2 0	7 0	12 0	11 5	17 0	18 5	5 0 × 12 0	30	Medium ○	12 5
1011 R	25 0	35 0	2 5	6 0	11 5	13 0	15 5	18 0	3 0 × 14 0	60	High ○	13 0
1011 L	24 0	37 0	2 5	6 5	11 5	12 0	16 0	18 0	3 0 × 15 0	50	High ○	16 0
1741 R	21 0	32 5	2 0	6 0	14 0	10 0	22 0	21 0	9 0 × 8 0	40	Low —	14 0
1741 L	22 0	32 0	3 0	7 0	13 0	12 0	17 0	18 0	5 0 × 10 0	45	Medium ○	15 0
1570 R	22 0	35 0	1 5	8 0	13 0	9 5	18 0	21 0	5 5 × 10 5	50	Medium ○	20 0
1570 L	23 0	35 0	2 0	9 0	14 0	11 0	12 0	20 0	6 0 × 13 0	40	High ○	16 0
1217 R	23 0	33 5	3 5	7 0	15 0	14 0	13 0	19 5	8 0 × 16 0	50	High ○	15 0
1217 L	22 0	33 5	4 5	7 0	13 5	15 0	15 0	19 5	8 0 × 18 0	40	Medium —	14 0
797 R	24 0	36 0	3 0	6 0	14 0	10 0	12 0	18 0	4 0 × 19 0	35	High ○	11 0
797 L	25 0	38 0	3 0	6 0	14 5	9 0	17 0	21 0	6 0 × 14 0	30	High ○	13 0
1255 R	22 0	31 5	3 5	5 5	12 5	11 0	15 5	17 5	5 5 × 19 0	35	High ○	12 0
1255 L	23 0	29 0	4 0	5 5	12 0	10 0	20 0	19 0	7 0 × 16 0	35	Low —	10 0
Maximum	27 0	37 5	6 0	9 5	15 5	16 5	23 5	22 5				21 0
Minimum	20 0	26 0	1 5	5 5	9 5	9 0	12 0	13 0				9 0
Average	23 7	33 3	3 1	7 4	13 2	12 0	17 6	18 6				13 9

\* All measurements are recorded in millimeters. Any angle listed in column J as 20 degrees measured 20 degrees or less. The sign ○ is used in column K to indicate roundness of the jugular fossa and the sign — to indicate flatness.

the extreme difference to be found is only 1.5 mm. In other words, this dimension is fairly constant under all conditions once adult life is reached. In the thickness (C) of the roof of the internal auditory canal there are considerable individual differences, but the averages are

TABLE 4—Group III from Table 1, with Individual Data Listed \*

Specimen	A	B	C	D	E	F	G	H	I	J	K	L
1488 R	23.0	31.5	3.0	6.0	12.0	13.0	18.0	21.0	12.5 × 7.0	50	Medium ○	17.0
1488 L	24.0	32.0	2.5	7.5	12.5	13.5	19.0	21.5	6.0 × 18.5	35	Low —	16.0
1553 R	28.0	35.0	3.0	7.5	13.5	15.0	13.0	17.0	8.0 × 14.0	45	High ○	16.0
1553 L	27.0	34.0	3.0	7.5	14.5	18.0	22.0	21.0	6.0 × 10.5	50	Medium —	18.0
1026 R	27.0	32.5	5.0	11.0	16.0	16.5	16.0	20.0	2.0 × 9.0	35	High ○	18.0
1460 R	26.0	30.5	4.5	9.0	13.5	13.0	14.0	16.0	4.0 × 8.5	30	High ○	18.0
1460 L	26.0	30.0	6.0	10.0	11.5	13.0	17.0	22.0	0	30	High ○	21.0
1458 R	25.0	31.5	3.0	10.0	14.5	11.0	21.5	22.0	6.0 × 11.0	55	Low —	15.0
1458 L	22.5	37.0	3.5	11.5	16.0	9.5	17.0	25.0	9.0 × 5.0	60	High ○	23.0
1382 R	24.0	34.0	3.0	4.5	14.5	15.5	21.5	19.0	6.0 × 16.0	35	Low —	11.0
1382 L	23.0	38.0	2.5	4.0	11.5	13.0	21.0	16.5	8.0 × 11.0	50	Low —	10.5
935 R	26.0	36.0	5.0	7.5	16.5	9.5	25.0	16.5	5.0 × 7.0	40	Medium —	15.0
935 L	27.0	38.5	4.5	10.0	15.0	14.0	23.5	16.0	5.0 × 11.5	45	Medium —	14.0
1203 R	25.0	35.0	2.5	7.5	13.0	13.0	20.0	17.0	5.0 × 23.0	50	Medium —	16.0
1203 L	27.0	35.5	3.0	8.0	12.0	15.0	20.5	16.0	4.0 × 20.0	45	Medium ○	14.0
1685 R	28.0	34.0	3.0	8.0	12.0	14.5	20.0	18.0	6.0 × 15.0	45	Low —	17.0
1685 L	26.0	35.0	4.0	7.5	13.0	14.5	19.0	15.0	6.0 × 13.0	30	Low —	18.0
1472 R	26.0	32.5	5.0	8.0	14.5	11.0	13.0	16.0	4.5 × 8.0	20	High ○	17.0
1472 L	28.0	32.0	3.0	7.0	15.0	10.5	20.0	22.0	8.0 × 8.0	20	Medium —	17.0
1167 R	29.0	36.0	5.0	9.0	15.0	12.0	15.0	20.0	11.5 × 6.0	40	High ○	11.0
1167 L	28.0	39.0	5.0	9.0	14.0	14.0	19.0	20.0	11.5 × 4.0	40	Medium —	13.0
Maximum	29.0	39.0	6.0	11.5	16.5	18.0	25.0	25.0	.	.		23.0
Minimum	22.5	30.0	2.5	4.0	11.5	9.5	13.0	15.0				10.5
Average	25.8	34.3	3.8	8.1	13.8	13.3	18.8	18.9				16.0

\* All measurements are recorded in millimeters. Any angle listed in column J as 20 degrees measured 20 degrees or less. The sign ○ is used in column K to indicate roundness of the jugular fossa and the sign — to indicate flatness.

TABLE 5—Group IV, from Table 1, with Individual Data Listed \*

Specimen	A	B	C	D	E	F	G	H	I	J	K	L
1439 L	27.0	31.0	2.0	13.0	15.0	17.0	16.0	18.0	5.0 × 10.5	40	High ○	15.0
1013 R	25.0	31.5	3.0	7.0	16.5	14.0	17.0	18.0	7.0 × 3.0	20	High ○	13.0
1013 L	24.0	30.0	3.0	9.0	13.0	15.0	15.0	17.0	3.0 × 13.0	20	High ○	13.0
1492 R	26.0	35.0	3.0	8.5	16.0	12.0	23.5	22.0	6.0 × 15.0	45	Low —	16.5
1492 L	28.0	34.0	3.0	7.5	13.5	11.5	11.0	20.0	7.0 × 10.0	40	High ○	19.0
1026 L	26.0	31.0	6.5	11.5	16.0	12.0	14.0	21.5	2.0 × 1.0	35	High ○	17.0
1514 R	26.0	37.0	4.0	8.0	15.0	14.0	23.5	23.0	8.0 × 22.0	45	Low —	17.0
1514 L	28.0	33.5	4.0	10.0	14.0	14.0	13.0	21.0	6.0 × 21.0	20	High ○	24.0
Maximum	28.0	37.0	6.5	13.0	16.5	17.0	23.5	22.0				24.0
Minimum	24.0	30.0	2.0	7.0	13.0	11.5	11.0	17.0				13.0
Average	26.2	32.8	3.5	9.3	14.8	13.7	16.6	20.0				16.8

\* All measurements are recorded in millimeters. Any angle listed in column I as 20 degrees measured 20 degrees or less. The sign ○ is used in column K to indicate roundness of the jugular fossa and the sign — to indicate flatness.

much alike. The average distance (D) from the internal carotid artery to the posterior surface of the pyramid in the midapical area increases from 7.7 mm in group I to 9.3 mm in group IV.

The position of the hiatus Fallopi measured from the posterior edge of the pyramid (F) is farther forward in group IV (13.7 mm) than in

group I (120 mm) The minimal distance from the jugular fossa to the top of the arcuate eminence (G) increases from 17.2 mm in group I to 17.6 mm in group II and to 18.8 mm in group III and then decreases to 16.6 mm in group IV. The relation of the anterior margin of the lateral sinus to the arcuate eminence, it is true, shows considerable range, but the averages of the four groups show no significant differences. Again, while the osseous dehiscence over the internal carotid artery shows considerable variation, there is no significance in the statistically

TABLE 6—*Skeletal Numbers of 100 Temporal Bones of 20 to 30 Year Old White Men Classified into Groups I to IV\**

I	II				III	IV
436 R & L	267 R & L	484 R & L	680 R & L	623 R & L	712 R & L	583 R & L
628 L	688 R & L	1327 R & L	94 R & L	1546 R & L	1160 R & L	667 R & L
614 R & L	1769 R & L	1612 R & L	2584 R & L	1393 R & L	2565 R & L	2041 R & L
341 R & L	1163 R & L	310 R & L	694 R & L	1039 R & L	360 R & L	423 R & L
1043 R & L	628 R	2192 R & L	471 R & L	469 R & L	575 R & L	1298 R
238 R & L	1298 L	2454 R & L	490 R	1674 R & L	424 R	503 R & L
	988 R & L	215 R & L	672 R & L	643 R & L	687 R & L	
	376 R & L	424 L	618 R & L	392 R & L	490 L	
	1873 R & L	288 R & L				

\* R = right, L = left—indicating individual temporal bones

TABLE 7—*Group I from Table 6, with Individual Data Listed\**

Specimen	A	B	C	D	E	F	G	H	I	J	K	L
436 R	24.0	26.0	3.0	4.0	12.0	8.5	13.5	16.5	6.0 × 10.0	60	High ○	8.0
436 L	24.0	35.0	3.0	5.0	12.0	11.0	14.0	21.0	6.0 × 12.5	60	High ○	8.0
628 L	21.0	32.0	2.5	7.5	10.0	7.5	13.0	16.0	6.0 × 7.0	20	High ○	9.0
614 R	23.0	34.5	2.0	10.5	11.5	13.5	15.0	17.0	3.5 × 8.0	35	High ○	12.0
614 L	24.0	31.0	3.0	10.0	14.0	12.0	17.0	21.5	3.5 × 8.0	40	High ○	18.0
341 R	20.0	35.5	4.0	6.5	13.0	12.0	17.0	16.0	4.0 × 10.5	50	High ○	10.0
341 L	20.5	33.0	4.0	6.5	14.5	14.0	16.5	17.0	3.0 × 9.0	50	High ○	13.0
1043 R	21.0	35.0	6.0	7.5	13.0	12.0	19.0	16.5	4.0 × 9.0	20	Medium ○	15.0
1043 L	26.0	32.0	6.0	8.5	14.5	11.5	20.0	18.5	6.0 × 11.0	20	Low —	13.0
238 R	25.0	33.0	2.5	7.0	12.0	8.5	19.5	20.5	4.0 × 13.0	40	Medium ○	12.0
238 L	25.0	32.0	3.5	6.0	13.5	7.0	15.5	19.5	3.5 × 13.5	35	High ○	11.0
Maximum	26.0	36.0	6.0	10.5	14.5	14.0	20.0	21.5				18.0
Minimum	20.0	31.0	2.0	4.0	10.0	7.0	13.0	16.5				8.0
Average	23.0	33.5	3.6	7.2	12.7	10.7	16.4	18.2				11.7

\* All measurements are recorded in millimeters. Any angle listed in column J as 20 degrees measured 20 degrees or less. The sign ○ is used in column K to indicate roundness of the jugular fossa and the sign — to indicate flatness.

reduced data. To this statement, however, specimen 1460 L presents an exception, for it has no bony dehiscence (1 only out of the 100 bones).

It is to be noticed that in specimen 899 L the angle formed by the posterior root of the zygoma as it turns up from the plane of the zygomatic arch is 30 degrees (J) and the minimal distance from the lateral sinus to the depression of Wilde (L) is 7.7 mm. Again, specimen 1236 L has an angle of 30 degrees with a distance of 7.7 mm, whereas in specimen 991 L there is an angle of 50 degrees and the distance is 11 mm, and specimen 1770 R has an angle of 35 degrees with a distance of

TABLE 8—Group II from Table 6, with Individual Data Listed\*

Specimen	A	B	C	D	E	F	G	H	I	J	K	L
267 R	22 0	36 0	2 5	6 5	15 0	11 0	14 0	18 0	5 0 × 8 5	20	High ○	9 0
267 L	22 0	37 5	4 0	6 5	12 5	9 5	23 0	21 5	4 0 × 9 0	20	Low —	13 5
638 R	19 0	34 5	3 5	7 5	12 0	9 0	16 5	17 0	5 0 × 12 5	40	Medium —	14 0
638 L	20 5	35 0	3 0	7 5	13 0	10 0	17 0	15 5	4 5 × 10 0	30	Medium —	12 0
1769 R	22 0	31 5	5 5	7 5	13 0	11 5	18 5	16 0	11 5 × 5 0	50	Medium —	12 0
1769 L	26 0	28 5	5 0	7 5	15 0	13 5	20 5	24 5	13 5 × 6 0	50	Low —	15 0
1163 R	23 0	33 0	5 0	8 0	13 0	11 5	19 0	17 0	10 0 × 7 0	45	Medium ○	17 0
1163 L	23 0	32 5	4 0	7 5	14 0	11 0	20 5	18 5	13 0 × 7 0	40	Medium —	17 0
628 R	20 0	35 0	2 5	8 0	11 5	8 0	16 0	16 0	5 0 × 9 0	25	Medium —	13 0
1298 L	22 0	31 5	3 5	6 0	16 5	10 5	16 0	19 0	4 0 × 17 0	20	High ○	11 5
958 R	20 0	36 0	4 0	8 0	12 5	11 5	16 5	22 0	5 0 × 11 0	40	High ○	17 0
958 L	21 0	35 5	4 0	9 5	14 5	19 0	16 0	18 5	4 5 × 10 0	55	High ○	13 0
376 R	21 0	37 0	4 0	5 5	12 5	9 5	22 0	19 5	6 0 × 11 0	45	Low —	14 0
376 L	20 0	36 5	5 0	7 0	14 0	11 5	19 0	17 0	12 5 × 6 0	45	Medium ○	13 0
1873 R	21 5	29 5	3 0	7 5	12 5	10 0	18 0	18 0	4 5 × 9 0	35	High ○	12 0
1873 L	21 0	29 5	2 0	8 0	13 0	13 5	20 0	21 5	6 0 × 12 0	30	High —	11 0
484 R	24 0	32 0	5 0	9 0	13 0	11 5	16 0	18 5	2 0 × 3 0	25	High ○	11 0
484 L	26 0	31 5	6 0	10 0	13 5	12 5	14 0	20 0	2 0 × 3 0	35	High ○	13 0
1327 R	20 0	35 0	4 0	6 0	14 0	7 5	23 0	21 5	3 0 × 7 0	45	Low —	17 0
1327 L	20 0	35 5	3 5	5 5	12 0	9 0	16 0	15 5	4 0 × 11 5	50	High ○	13 0
1612 R	23 0	36 5	4 5	7 0	17 0	12 5	15 0	18 0	5 0 × 8 0	45	High ○	18 0
1612 L	23 0	37 5	4 0	8 0	14 0	12 0	22 0	22 5	5 0 × 8 0	25	Low —	14 0
310 R	25 0	35 0	3 5	6 0	12 5	11 0	20 0	22 0	5 0 × 10 0	20	High —	12 0
310 L	25 0	33 5	3 0	8 0	12 5	10 0	21 0	20 5	6 0 × 12 0	45	Medium —	9 0
2192 R	23 0	33 0	2 5	6 0	15 0	11 0	16 5	18 5	0	25	High ○	11 0
2192 L	24 0	34 5	3 0	8 0	16 5	17 0	14 5	17 0	4 0 × 7 0	35	High ○	8 5
2454 R	22 5	37 5	2 5	5 5	12 5	12 0	17 0	18 0	5 0 × 7 0	30	High ○	12 0
2454 L	23 0	33 5	2 5	6 0	13 5	11 5	15 0	17 5	4 5 × 4 0	30	High ○	12 0
215 R	22 5	35 5	4 5	10 0	17 0	11 5	24 0	18 0	4 0 × 13 5	40	Medium —	15 0
215 L	22 0	36 0	4 0	8 0	17 5	9 5	22 0	17 5	4 5 × 14 0	35	High —	11 0
288 R	24 0	35 5	4 0	8 0	14 0	10 0	21 5	21 0	5 0 × 10 5	25	High ○	12 0
424 L	25 0	38 0	4 5	8 5	12 5	10 0	22 5	16 5	5 0 × 10 5	20	Low —	15 0
288 L	24 0	34 5	3 5	7 5	15 0	10 0	20 5	19 0	4 0 × 11 0	25	High ○	12 0
650 R	22 0	38 0	4 0	8 5	11 5	12 5	24 0	15 5	5 0 × 5 0	20	Low —	16 0
680 L	27 0	30 5	4 0	8 5	13 0	13 5	19 0	22 0	2 0 × 2 0	20	Low —	17 5
94 R	25 0	38 0	3 0	5 0	16 0	10 0	19 5	18 0	4 0 × 18 5	45	High —	14 0
94 L	26 0	36 5	3 5	6 0	13 0	12 0	17 0	20 5	4 5 × 17 0	40	Medium ○	19 0
2584 R	25 0	33 5	4 0	7 0	13 5	13 0	17 0	19 0	5 5 × 11 0	40	Medium ○	17 0
2584 L	26 0	34 5	3 5	7 0	14 0	12 0	21 5	12 5	5 0 × 8 0	35	Low —	24 0
694 R	19 0	37 5	2 5	6 5	10 5	10 0	19 0	14 5	6 0 × 7 0	30	Low —	13 0
694 L	21 5	37 0	3 0	7 0	12 0	12 0	18 5	12 5	5 0 × 9 5	20	Low —	8 0
471 R	20 0	35 0	3 0	7 0	13 5	9 0	15 0	17 0	6 0 × 9 5	70	High ○	15 0
471 L	22 0	36 0	3 5	7 0	14 0	10 5	22 0	19 0	9 0 × 6 0	45	Low —	15 0
490 R	22 0	35 0	4 0	8 0	15 0	13 5	15 0	11 5	1 0 × 3 0	30	High ○	9 0
672 R	20 0	39 0	2 7	8 0	11 5	10 5	24 5	17 0	10 0 × 4 0	35	Low —	16 0
672 L	25 0	33 0	3 5	9 5	13 0	10 5	16 0	13 5	4 0 × 6 0	25	High ○	11 0
618 R	21 0	36 0	2 5	7 5	12 0	8 5	15 0	13 5	6 0 × 10 0	45	High ○	18 0
618 L	21 0	35 5	3 0	7 0	12 5	9 5	20 0	17 0	7 0 × 13 0	35	Medium ○	11 0
623 R	24 0	35 5	3 0	8 5	15 5	10 0	18 5	21 0	7 0 × 14 0	20	High ○	16 0
623 L	26 0	38 0	2 5	8 5	14 0	10 0	18 0	19 0	5 0 × 13 0	30	High ○	13 0
1546 R	23 0	33 5	4 0	9 5	15 0	10 5	14 0	17 5	5 0 × 10 0	30	High ○	17 0
1546 L	24 0	33 5	4 5	9 0	15 0	12 0	16 0	21 0	4 0 × 10 5	35	High ○	14 0
1393 R	26 0	36 0	1 0	7 0	10 0	11 0	14 0	18 5	3 0 × 7 0	35	High ○	15 5
1393 L	24 0	35 0	1 0	6 0	10 5	12 0	14 0	17 5	3 5 × 11 0	35	High ○	16 0
1039 R	22 0	31 5	3 5	6 5	13 0	8 0	16 5	17 5	6 0 × 6 0	40	High ○	13 0
1039 L	23 0	34 5	3 0	6 0	12 5	9 0	16 5	15 0	7 0 × 18 0	20	High —	9 0
469 R	22 0	34 5	3 0	6 5	12 5	11 0	15 0	15 5	5 0 × 8 0	20	High ○	11 0
469 L	23 0	35 5	3 5	7 0	13 5	13 0	16 0	14 5	3 0 × 16 0	25	High ○	12 5
1674 R	23 0	36 5	4 0	7 5	15 0	11 0	20 0	27 0	5 0 × 9 0	45	High ○	15 0
1674 L	23 0	39 0	4 0	7 0	15 0	10 0	22 0	20 5	5 0 × 12 0	35	High —	15 0
643 R	22 0	35 0	3 0	7 0	15 0	10 5	14 0	14 0	4 0 × 5 0	40	High ○	17 0
643 L	23 0	37 0	3 0	6 0	14 0	9 5	17 0	15 5	1 0 × 3 0	45	High ○	16 0
392 R	27 0	35 0	3 7	8 5	12 5	16 0	16 0	23 0	4 5 × 10 5	35	High ○	19 0
392 L	24 0	40 5	3 7	9 5	13 0	16 5	18 0	20 0	4 0 × 14 0	35	High ○	19 0
Maximum	27 0	40 5	6 0	10 0	17 5	19 0	24 5	27 0				24 0
Minimum	19 0	29 5	1 0	5 0	10 0	7 5	14 0	11 5				8 0
Average	22 8	35 0	3 5	7 4	13 6	11 2	18 1	18 2				13 9

\* All measurements are recorded in millimeters. Any angle listed in column J as 20 degrees measured 20 degrees or less. The sign ○ is used in column K to indicate roundness of the jugular fossa and the sign — to indicate flatness.



17.0 mm. From these examples it is obvious that a small angle (J) does not necessarily imply a long distance (L) nor a great angle a short distance. The angulation of the posterior root of the zygoma, therefore, possesses no clinical significance even for group I, in regard to which its

TABLE 9—Group III from Table 6, with Individual Data Listed \*

Specimen	A	B	C	D	E	F	G	H	I	J	K	L
712 R	27.0	41.0	3.0	8.0	15.0	14.5	18.0	19.0	3.0 × 2.0	35	High ○	19.0
712 L	27.0	42.5	3.0	8.0	15.5	15.0	17.0	17.5	2.0 × 8.5	25	High ○	17.0
1160 R	20.0	32.0	3.5	7.0	11.0	13.0	16.0	26.0	7.0 × 6.5	20	High ○	21.0
1160 L	25.0	34.0	4.0	7.5	13.0	15.5	20.0	21.5	6.0 × 7.5	35	Medium ○	22.0
2565 R	23.0	35.0	2.5	7.0	12.0	10.5	17.0	22.5	4.5 × 15.5	20	High —	18.0
2565 L	27.0	34.0	2.5	8.0	14.5	10.5	12.0	19.0	5.0 × 16.5	20	High ○	14.0
360 R	24.0	40.0	3.0	8.0	11.0	12.0	24.5	11.5	6.0 × 14.5	40	Low —	16.0
360 L	26.0	33.0	4.0	6.0	13.0	9.5	16.0	18.0	5.0 × 14.0	10	High ○	14.0
575 R	22.0	32.5	3.0	8.0	11.0	14.0	17.0	10.0	5.0 × 9.5	25	High ○	15.0
575 L	24.0	32.5	3.0	8.0	13.0	12.0	22.5	17.5	3.0 × 4.0	25	Low —	15.0
424 R	24.0	36.0	5.0	8.0	13.5	11.5	21.0	19.5	4.0 × 10.0	20	Low —	20.5
687 R	26.0	36.0	4.0	10.5	14.0	17.0	23.5	19.0	4.5 × 18.0	35	Medium —	20.0
687 L	26.0	33.0	4.5	11.0	13.5	15.0	24.5	10.5	3.0 × 2.0	40	Medium —	20.5
490 L	24.0	34.0	4.0	7.0	13.5	13.5	17.5	18.0	4.5 × 7.0	45	High ○	13.0
Maximum	27.0	42.5	5.0	11.0	15.5	17.0	24.5	26.0				22.0
Minimum	20.0	32.0	2.5	7.0	11.0	9.5	16.0	11.5				13.0
Average	24.6	35.5	3.5	8.0	13.1	13.1	19.0	19.1				17.5

\* All measurements are recorded in millimeters. Any angle listed in column J as 20 degrees measured 20 degrees or less. The sign ○ is used in column K to indicate roundness of the jugular fossa and the sign — to indicate flatness.

TABLE 10—Group IV from Table 6, with Individual Data Listed \*

Specimen	A	B	C	D	E	F	G	H	I	J	K	L
583 R	22.0	34.0	4.5	10.0	14.5	14.5	22.5	23.0	6.0 × 10.0	35	Low —	16.0
583 L	24.0	30.0	5.5	9.5	15.0	13.0	19.0	18.0	8.0 × 7.0	40	Medium ○	12.0
667 R	25.0	33.0	4.0	7.0	13.5	15.5	24.0	18.5	8.0 × 7.0	20	Low —	14.0
667 L	24.0	32.5	5.0	7.5	16.5	16.0	20.0	18.0	6.0 × 10.0	35	Medium ○	14.0
2041 R	25.0	38.0	3.0	6.5	12.0	11.0	18.0	17.5	7.0 × 9.0	40	High —	20.0
2041 L	29.0	35.5	3.0	6.5	12.0	13.5	23.5	19.0	2.5 × 18.0	40	Low —	19.0
423 R	25.0	36.0	4.0	7.5	14.5	11.5	19.0	15.0	5.5 × 7.0	20	Low —	16.0
423 L	26.0	36.5	4.0	8.0	14.0	13.5	22.0	18.5	6.0 × 11.0	25	Low —	19.0
1298 R	22.0	32.5	3.0	5.0	15.5	9.5	20.0	17.5	6.0 × 20.0	35	High ○	12.0
503 R	22.0	39.0	5.5	9.0	16.0	13.5	24.0	18.5	5.0 × 11.0	40	Low —	20.0
503 L	26.0	36.0	6.0	7.5	16.0	13.5	26.0	21.0	6.0 × 7.5	25	Low —	16.0
Maximum	29.0	39.0	6.0	10.0	16.5	16.0	26.0	23.0				20.0
Minimum	22.0	30.0	3.0	5.0	12.0	9.5	18.0	15.0				12.0
Average	24.5	34.8	4.3	7.6	14.5	13.2	21.6	18.6				16.2

\* All measurements are recorded in millimeters. Any angle listed in column J as 20 degrees measured 20 degrees or less. The sign ○ is used in column K to indicate roundness of the jugular fossa and the sign — to indicate flatness.

meaning might have been expected to be most significant in surgery. As Wittmaack<sup>2</sup> has said, the forward position of the lateral sinus occurs only in pathologic pneumatization. Returning to the dimension (L) between the lateral sinus and the depression of Wilde, one finds a gradual increase from 11.5 mm. in group I to 13.9 mm. in group II, to 16.0 mm. in group III and to 16.8 mm. in group IV. The significance

of this is that the bones which are free from arrest naturally show inflation and therefore a larger dimension than the bones in which pneumatization was arrested in early life

In a more general way specimens from this series of bones of 55 to 65 year old men may be compared with a series of men of 20 to 30 years. It is a striking and significant fact that the morphologic features

TABLE 11—*Skeletal Numbers of 100 Temporal Bones of 20 to 30 Year Old Negro Men Classified into Groups I to IV\**

I	II		III		IV
1699 R & L	855 R & L	1092 R & L	2203 L	874 R & L	2203 R
1312 R & L	809 R	859 R & L	2009 R & L	862 R & L	1201 R & L
970 R	970 L	959 L	1072 R & L	782 R & L	857 R & L
1361 R & L	792 R & L	1233 R	778 R & L	1204 R & L	1360 R & L
1084 R & L	1014 R & L	1094 R	791 R & L	1086 R & L	846 R & L
1372 R & L	1134 R & L	569 R & L	716 R & L	1112 L	858 L
	1054 R & L	2281 R & L	1360 R & L	703 L	1112 R
	1141 R & L	1967 R & L	1044 R & L	959 R	
	703 R	568 R & L	809 L	1233 L	
	941 R & L	2060 R & L	1278 R & L	1094 L	
	860 R & L	1957 R & L	1742 R & L		
	858 R	1682 R & L			
	1442 R & L				

\* R = right, L = left—indicating individual temporal bones

TABLE 12—*Group I from Table 11, with Individual Data Listed\**

Specimen	A	B	C	D	E	F	G	H	I	J	K	L
1699 R	19.0	34.0	3.0	7.5	10.0	12.5	14.0	13.0	5.0 × 8.0	35	High —	7.0
1699 L	21.0	31.0	4.0	8.0	11.0	13.5	15.5	15.5	3.0 × 11.0	45	Medium —	8.0
1312 R	20.0	34.0	2.0	4.0	9.0	11.0	15.0	20.0	5.0 × 11.0	45	High ○	6.0
1312 L	20.0	36.5	2.5	4.0	10.5	11.0	14.0	14.5	3.0 × 10.0	50	High ○	3.5
970 R	18.0	32.5	5.0	8.5	15.0	10.0	15.0	16.5	2.0 × 7.0	35	High ○	8.0
1361 R	21.5	35.0	2.0	6.5	11.0	12.0	17.0	22.0	5.0 × 10.0	55	Medium ○	9.0
1361 L	22.0	35.5	2.5	6.0	11.0	14.0	12.0	19.0	5.0 × 11.0	45	High ○	6.0
1084 R	21.0	35.0	4.5	7.0	12.0	13.5	17.0	14.5	5.0 × 12.0	45	High ○	13.0
1084 L	22.0	35.5	3.0	8.5	11.5	13.5	16.5	16.0	4.0 × 8.0	40	High ○	9.0
1372 R	19.0	33.0	4.0	8.0	11.0	13.0	15.5	16.0	7.0 × 11.0	50	Medium ○	6.0
1372 L	21.0	36.5	3.5	9.5	11.0	14.0	16.0	16.5	7.0 × 11.0	40	Medium —	5.5
Maximum	22.0	38.0	5.0	9.5	15.0	14.0	17.0	22.0				13.0
Minimum	18.0	31.0	2.0	4.0	9.0	10.0	12.0	13.0				3.5
Average	20.4	34.9	3.2	7.0	11.2	12.5	15.2	16.7				7.3

\* All measurements are recorded in millimeters. Any angle listed in column J as 20 degrees measured 20 degrees or less. The sign ○ is used in column K to indicate roundness of the jugular fossa and the sign — to indicate flatness.

(A through L) of the bones of younger men, when the corresponding groups of the two series are compared, show no significant difference in average measurement. To inquire what part, if any, racial stock plays in these data, one may compare the series of bones of 20 to 30 year old white men with the specimens from 20 to 30 year old Negro men. The two present identical numbers of bones under headings group I and group IV. When groups II and III are added together (and it must be admitted that there is often considerable difficulty in assign-

ment to one or the other of these groups), the two series again present identical numbers. More bones from the white men (compare groups II of the various series) show development arrested early in life as compared with those from Negroes. It may be that the Negro escapes

TABLE 13—Group II from Table 11, with Individual Data Listed \*

Specimen	A	B	C	D	E	F	G	H	I	J	K	L
855 R	23.0	33.0	3.5	7.5	11.0	11.0	16.0	17.0	7.0 × 10.0	50	Medium ○	9.0
855 L	21.0	35.0	5.0	7.5	10.0	10.0	16.0	17.5	5.0 × 14.0	35	Medium ○	10.0
809 R	25.0	37.5	3.5	10.5	13.0	15.0	15.0	16.5	6.0 × 7.0	45	High ○	12.0
970 L	20.0	32.0	4.5	7.0	12.5	11.0	17.5	16.5	3.0 × 11.0	30	Medium ○	10.0
792 R	22.0	37.0	3.0	7.0	12.0	16.0	17.5	22.0	5.0 × 8.0	35	High ○	13.0
792 L	25.0	34.5	3.5	7.5	12.5	15.5	17.0	21.5	4.0 × 9.0	40	High ○	11.0
1014 R	22.0	33.0	3.0	8.5	10.5	13.0	14.0	21.0	7.0 × 7.0	50	High ○	11.0
1014 L	23.0	31.0	4.0	8.5	10.0	13.5	19.0	20.0	5.0 × 5.0	40	Low —	10.5
1134 R	24.0	38.0	3.5	10.5	14.0	11.5	15.0	18.0	7.0 × 10.0	40	High ○	6.0
1134 L	24.0	39.5	4.5	10.0	13.5	13.0	21.0	21.0	11.0 × 8.0	55	Low —	8.0
1054 R	20.0	34.0	4.0	6.0	12.0	19.0	17.0	15.0	5.0 × 14.0	40	Medium ○	11.0
1054 L	21.0	35.5	3.5	7.5	12.0	9.5	18.5	17.0	5.0 × 11.0	40	Medium ○	10.5
1141 R	21.0	35.0	4.5	8.5	16.0	10.5	16.0	19.0	10.0 × 4.0	60	High ○	11.0
1141 L	19.0	36.5	4.5	10.0	16.0	11.0	24.0	24.0	4.0 × 13.0	60	Low —	12.0
703 R	24.0	35.0	6.0	8.0	13.5	14.0	21.0	16.5	5.0 × 12.0	45	Low —	14.0
941 R	23.0	33.0	4.5	9.5	14.0	13.0	20.0	22.0	3.0 × 5.0	40	Low —	15.0
941 L	25.0	32.0	5.0	10.0	13.0	12.5	13.0	18.0	2.0 × 3.0	50	High ○	16.0
860 R	24.0	36.0	4.0	5.0	11.0	11.5	20.0	24.0	1.0 × 3.0	20	Low —	11.0
860 L	24.0	35.0	4.5	4.0	11.0	13.0	17.0	18.0	4.0 × 14.0	20	Medium ○	6.0
858 R	18.0	40.0	3.0	8.0	11.0	10.0	18.0	18.5	0	25	Medium —	11.0
1442 R	22.5	35.0	4.5	6.0	12.0	13.0	12.5	17.0	7.0 × 9.0	50	High ○	14.0
1442 L	25.0	35.0	6.0	7.0	14.0	14.0	24.0	22.0	6.0 × 7.0	45	Low —	12.0
1092 R	23.0	32.5	6.0	8.5	14.5	15.0	19.0	17.5	0	40	Medium ○	13.0
1092 L	24.0	34.0	7.5	9.0	15.0	16.5	19.5	16.0	0	50	Medium ○	14.0
859 R	21.5	35.0	4.0	6.5	13.0	10.5	15.5	19.0	6.0 × 7.0	30	High ○	16.0
859 L	22.0	34.5	3.0	5.0	12.0	11.0	20.0	19.0	3.0 × 11.5	25	Low —	14.0
959 L	24.0	33.0	4.5	10.0	13.0	16.5	12.0	19.0	2.0 × 3.0	35	High ○	10.0
1233 R	26.0	38.0	4.0	10.0	15.0	17.0	22.5	27.0	4.0 × 6.0	55	Low —	16.0
1094 R	24.0	33.0	4.5	8.0	11.5	13.0	15.5	17.0	3.0 × 5.0	40	Medium —	10.0
569 R	22.0	35.0	5.0	8.5	12.0	11.5	21.5	20.0	6.0 × 10.0	40	Low —	9.0
569 L	18.0	41.0	5.0	9.0	12.5	15.5	16.0	13.5	4.0 × 14.0	40	High ○	10.0
2281 R	22.0	32.0	1.5	3.5	13.0	10.5	16.0	22.0	6.0 × 14.0	50	Medium ○	14.0
2281 L	23.0	30.5	1.0	5.0	14.0	12.5	19.0	19.0	5.0 × 14.0	40	Low —	16.0
1967 R	27.0	39.5	2.0	7.0	12.0	12.5	18.5	19.5	4.0 × 9.0	40	Medium ○	17.0
1967 L	24.0	38.5	2.5	8.0	12.0	12.5	14.0	18.0	4.0 × 9.0	55	High ○	17.0
568 R	25.0	36.0	2.0	8.0	11.0	13.0	20.5	17.0	4.0 × 11.0	35	Low —	10.0
568 L	27.0	36.0	3.0	8.5	11.0	13.5	24.0	23.0	4.0 × 14.0	50	Low —	16.0
2060 R	25.0	40.0	1.5	8.5	11.0	15.5	16.5	16.0	3.0 × 6.0	50	High ○	9.0
2060 L	24.0	37.5	2.0	9.0	15.0	16.0	19.0	18.0	7.0 × 10.0	40	Low —	9.0
1957 R	20.0	34.0	3.5	6.0	10.0	14.5	20.0	17.0	4.0 × 15.0	40	Low —	11.5
1957 L	20.5	33.0	4.0	6.5	11.0	15.0	18.0	18.0	4.0 × 16.0	50	Medium ○	10.0
1682 R	23.0	34.0	4.0	8.0	13.0	15.5	14.0	19.0	5.0 × 11.0	50	High ○	12.0
1682 L	24.0	34.0	4.0	7.0	12.0	12.0	22.0	23.0	3.0 × 12.0	35	Low ○	14.0
Maximum	27.0	41.0	7.5	10.5	16.0	19.0	24.0	27.0				17.0
Minimum	18.0	30.5	1.0	4.0	10.0	9.5	12.0	13.5				6.0
Average	22.9	35.2	3.9	7.8	12.5	13.3	18.0	19.0				11.9

\* All measurements are recorded in millimeters. Any angle listed in column J as 20 degrees measured 20 degrees or less. The sign ○ is used in column K to indicate roundness of the jugular fossa and the sign — to indicate flatness.

the retarding influence more than the white person during this phase of life, or else more of those afflicted die in childhood. In the morphologic features (A through L), one finds no significant differences between the races. Hence, from the standpoint of structure and of

TABLE 14—Group III from Table 11, with Individual Data Listed \*

Specimen	A	B	C	D	E	F	G	H	I	J	K	L
2203 L	26 0	33 0	3 5	9 0	15 0	14 5	20 5	19 0	50 × 13 0	35	Low —	20 0
2009 R	20 0	39 0	4 5	7 0	13 0	13 5	15 5	11 0	50 × 15 0	30	High ○	14 0
2009 L	24 0	33 0	4 0	6 0	12 5	13 0	18 0	17 0	50 × 18 0	35	Low —	15 0
1072 R	23 0	30 0	5 0	8 0	14 0	13 0	18 0	16 5	20 × 30	35	Medium ○	14 0
1072 L	24 0	31 5	4 5	8 5	13 0	12 5	20 5	16 5	30 × 50	35	Low —	16 0
778 R	27 0	35 0	6 0	10 0	16 0	15 0	21 5	16 0	0	35	Low —	19 0
778 L	26 5	36 0	7 0	9 0	17 0	13 5	27 0	18 5	0	35	Low —	18 0
791 R	24 0	35 0	5 0	6 5	13 0	13 5	17 0	16 0	50 × 70	30	High ○	14 0
791 L	28 0	33 0	5 0	7 0	12 5	14 0	19 5	18 0	70 × 70	35	Low —	15 0
716 R	24 0	39 5	6 0	7 5	13 0	14 5	17 0	16 0	30 × 110	55	High ○	17 0
716 L	27 0	40 0	6 0	8 0	15 5	16 0	21 5	17 0	50 × 130	55	Low —	17 0
1360 R	25 0	36 0	4 0	9 0	12 0	15 0	21 0	21 5	0	35	Low —	18 0
1360 L	25 0	35 5	5 0	6 0	13 0	16 0	18 0	19 5	60 × 40	20	Medium ○	16 0
1044 R	24 0	32 0	5 5	9 0	13 5	12 0	18 0	16 0	0	35	Low —	10 0
1044 L	24 0	33 5	5 5	8 0	14 0	13 5	19 5	17 0	0	35	Low —	9 5
809 L	23 0	41 0	5 0	11 0	14 0	10 5	19 0	18 0	40 × 60	45	Medium ○	14 0
1278 R	25 0	36 0	3 0	7 5	12 0	15 5	21 5	16 0	30 × 120	20	Low —	14 0
1278 L	26 5	36 0	3 0	8 0	13 0	14 0	18 0	17 0	30 × 110	20	Medium ○	14 0
1742 R	26 0	34 5	4 5	10 5	12 0	18 0	16 0	20 0	40 × 110	25	Medium ○	14 0
1742 L	28 0	36 0	6 0	10 5	13 5	18 5	18 0	23 0	40 × 70	25	Medium —	11 5
874 R	25 0	34 0	3 0	8 5	15 5	14 5	22 5	15 0	0	20	Low —	17 0
874 L	23 0	34 5	3 0	8 0	15 0	13 0	22 0	10 0	20 × 40	40	Low —	17 5
862 R	25 0	36 0	4 0	8 0	14 0	17 0	17 0	19 0	60 × 90	60	Medium ○	18 5
862 L	24 5	34 5	4 0	9 0	16 5	13 0	21 0	20 0	60 × 70	55	Low —	16 0
782 R	25 0	39 0	5 0	8 5	12 0	14 5	20 0	19 5	160 × 60	30	High ○	19 0
782 L	27 0	37 0	4 5	9 5	12 5	14 0	24 0	21 5	60 × 170	40	Low —	16 0
1204 R	22 0	39 0	5 0	8 0	12 0	13 0	20 0	14 5	20 × 20	25	Medium ○	16 5
1204 L	23 0	40 0	5 5	10 0	15 0	16 0	21 0	15 0	50 × 40	35	Medium —	18 0
1086 L	27 0	30 5	3 5	8 0	13 0	13 5	12 0	21 0	30 × 30	40	High ○	13 0
1112 L	21 0	30 5	5 0	8 0	11 5	12 0	18 5	14 5	40 × 60	50	Low —	12 0
703 L	25 0	38 0	5 0	6 5	15 0	13 0	22 5	18 0	40 × 120	60	Low —	15 0
959 R	25 0	34 0	5 5	11 0	15 5	13 5	21 5	22 5	40 × 100	35	Low —	14 0
1233 L	26 0	36 0	5 5	9 0	15 0	19 0	17 0	21 5	0	55	High ○	17 0
1094 L	21 0	36 0	4 5	7 0	11 5	13 0	18 0	16 0	60 × 90	50	Medium ○	14 0
1086 R	24 0	32 0	3 5	9 5	11 0	15 0	16 0	22 0	50 × 60	40	High ○	12 0
Maximum	28 0	41 0	7 0	11 0	17 0	19 0	27 0	23 0				20 0
Minimum	20 0	30 0	3 0	6 0	11 0	10 5	12 0	10 0				9 5
Average	24 8	35 3	4 7	8 4	13 6	14 3	19 3	17 7				15 3

\* All measurements are recorded in millimeters. Any angle listed in column J as 20 degrees measured 20 degrees or less. The sign ○ is used in column K to indicate roundness of the jugular fossa and the sign — to indicate flatness.

TABLE 15—Group IV from Table 11, with Individual Data Listed \*

Specimen	A	B	C	D	E	F	G	H	I	J	K	L
2203 R	24 0	31 5	3 0	8 0	14 0	12 5	20 0	17 0	50 × 120	30	Low —	15 0
1201 R	26 0	35 0	4 0	8 0	13 5	13 5	20 5	20 5	50 × 50	30	Low —	19 0
1201 L	26 0	37 0	3 0	8 0	14 0	10 0	23 0	14 0	70 × 70	25	Low —	17 0
857 R	25 0	35 0	5 0	11 5	15 5	16 5	21 0	21 5	50 × 70	50	Low —	13 0
857 L	25 0	32 0	5 0	11 0	16 5	15 0	23 0	22 0	30 × 40	40	Low —	15 0
1360 R	24 0	38 0	4 0	11 0	12 0	16 0	13 0	18 0	0	20	High ○	15 0
1360 L	23 0	37 0	4 5	10 0	11 5	11 0	22 0	19 5	0	20	Low —	14 0
846 R	29 0	38 0	5 0	9 0	12 0	16 0	20 5	17 0	30 × 50	40	Low —	18 0
846 L	29 0	35 5	4 5	9 0	12 0	15 0	20 0	19 0	70 × 90	35	Medium —	18 0
858 L	22 0	33 0	2 0	11 5	14 5	9 5	16 0	23 0	0	20	High ○	12 0
1112 R	21 0	30 0	5 0	8 5	11 5	14 0	16 0	16 0	10 × 20	50	High ○	12 0
Maximum	29 0	38 0	5 0	11 5	16 5	16 5	23 0	23 0				19 0
Minimum	21 0	30 0	2 0	8 0	11 5	9 5	13 0	14 0				12 0
Average	24 9	34 7	4 1	9 6	13 4	13 5	19 5	18 9				15 3

\* All measurements are recorded in millimeters. Any angle listed in column J as 20 degrees measured 20 degrees or less. The sign ○ is used in column K to indicate roundness of the jugular fossa and the sign — to indicate flatness.

TABLE 16—*Skeletal Numbers of 78 Temporal Bones of Persons 16 to 20 Years Old Classified into Groups I to IV*

I	II		III		IV	
696 R	1228 R & L	291 R & L	1140 L	576 R & L	639 R & L	1232 R & L
693 R & L	1140 R	1040 R & L	563 R & L	410 R & L	588 R	519 R & L
1606 R & L	17 R & L	1589 R & L	548 L	2553 R & L	955 L	854 R
2796 R	1328 R & L	1974 R & L	583 L	854 L	964 L	527 R & L
	696 L	1949 R & L	964 R	2796 L	1012 R & L	807 R & L
	1590 R & L	1707 R & L	1109 R & L	721 R & L	1097 R & L	955 R
	2065 R & L	1339 R & L			2104 R & L	548 R
	1704 R & L	695 R & L				
	1575 R & L					

\* No distinction has been made as to color or sex R = right L = left—indicating individual temporal bones

TABLE 17—*Group I from Table 16, with Individual Data Listed \**

Specimen	A	B	C	D	E	F	G	H	I	J	K	L
696 R	18 0	33 0	5 0	7 0	17 0	11 0	19 0	16 5	12 5 × 3 0	65	High ○	12 0
693 R	20 0	35 0	3 5	6 0	10 0	13 0	18 0	12 5	6 0 × 17 0	50	High ○	15 0
693 L	21 0	34 0	3 0	6 0	10 0	14 0	19 0	16 5	3 0 × 14 0	50	Medium —	15 0
1606 R	22 0	33 0	4 0	7 5	12 0	14 0	14 0	18 0	9 0 × 4 0	25	High ○	11 0
1606 L	22 0	34 0	5 0	9 0	13 0	15 0	14 0	20 0	10 0 × 4 0	55	High ○	9 0
2796 R	22 0	32 5	4 0	10 0	13 5	10 5	21 0	22 0	7 0 × 11 0	20	Medium —	13 0
Maximum	22 0	35 0	5 0	10 0	17 0	15 0	19 0	22 0				15 0
Minimum	18 0	32 5	3 0	6 0	10 0	10 0	14 0	12 0				9 0
Average	20 8	33 6	4 1	7 6	12 6	12 9	17 5	17 6				12 5

\* All measurements are recorded in millimeters Any angle listed in column J as 20 degrees measured 20 degrees or less The sign ○ is used in column K to indicate roundness of the jugular fossa and the sign — to indicate flatness

TABLE 18—*Group II from Table 16, with Individual Data Listed \**

Specimen	A	B	C	D	E	F	G	H	I	J	K	L
1228 R	22 0	36 0	4 5	8 5	16 5	13 5	17 0	19 0	6 0 × 7 0	35	High ○	17 0
1228 L	26 0	32 0	5 0	8 5	17 0	15 0	18 0	20 0	6 0 × 7 0	40	High ○	17 0
1140 R	28 5	35 0	5 5	9 0	13 0	14 0	20 0	23 0	5 0 × 7 0	45	High ○	15 0
17 R	23 0	34 0	3 0	8 0	11 0	12 0	15 0	17 0	7 0 × 4 0	20	High ○	6 0
17 L	24 0	35 0	2 5	7 0	11 0	13 0	14 0	13 5	6 0 × 3 0	20	High ○	11 0
1328 R	26 0	28 0	4 0	9 0	11 5	14 5	13 0	16 5	3 0 × 7 0	60	High ○	15 0
1328 L	25 0	30 0	5 0	8 0	11 0	14 0	20 0	17 0	2 0 × 3 0	55	Low —	15 0
696 L	19 0	29 5	5 0	8 0	15 0	13 0	21 0	15 0	1 0 × 7 0	55	Medium —	10 0
1590 R	21 0	36 0	3 0	9 0	13 5	14 5	17 0	19 0	5 0 × 3 0	20	Medium —	11 0
1590 L	20 0	38 0	2 5	8 0	11 0	14 5	16 5	22 0	5 0 × 5 0	20	Medium —	14 0
2065 R	24 0	28 5	3 5	8 5	10 5	15 0	16 5	22 0	2 0 × 3 0	40	Medium —	11 0
2065 L	24 0	27 5	4 0	9 0	10 5	16 5	13 0	21 0	1 0 × 1 0	40	High ○	8 0
1704 R	24 0	34 0	3 5	9 0	12 0	15 0	18 0	18 0	6 0 × 8 5	35	Medium ○	13 0
1704 L	24 0	35 0	5 0	11 0	11 5	17 5	19 0	18 0	7 0 × 6 0	45	Medium —	15 0
1575 R	25 0	35 5	4 5	8 5	12 0	13 0	18 0	20 0	6 0 × 12 5	55	Medium —	14 0
1575 L	24 0	37 5	5 0	8 5	11 0	12 0	16 5	16 5	8 0 × 6 0	50	Medium ○	14 0
291 R	20 0	35 0	5 0	8 5	13 0	11 5	19 0	18 0	16 0 × 7 0	20	High —	10 0
291 L	22 0	37 0	4 0	8 0	13 5	11 5	24 0	19 0	6 0 × 16 0	20	Low —	13 0
1040 R	21 0	33 0	3 0	8 0	10 0	15 0	17 0	16 0	3 0 × 6 0	30	High ○	10 0
1040 L	20 0	33 5	3 0	7 0	11 0	14 5	18 0	22 0	3 0 × 4 0	45	Medium ○	12 0
1589 R	24 0	33 0	3 0	7 0	11 0	11 0	19 0	22 0	3 0 × 8 0	30	Medium —	12 0
1589 L	23 0	31 0	3 0	9 0	12 0	11 0	18 0	18 0	6 0 × 8 0	30	Medium —	9 0
1974 R	25 0	31 5	5 0	9 0	13 0	17 5	20 0	20 0	4 0 × 7 0	30	Medium —	13 0
1974 L	26 0	33 0	3 0	9 0	13 0	17 5	21 5	21 0	3 0 × 8 0	35	Medium —	14 0
1949 R	26 0	34 5	6 0	8 0	17 0	17 0	15 5	21 5	1 0 × 3 0	45	High —	15 0
1949 L	24 0	33 0	5 5	8 0	13 0	17 0	15 5	22 0	0	50	High ○	16 0
1707 R	22 0	33 0	3 0	6 0	12 0	11 5	18 0	22 0	15 0 × 4 0	40	Low —	13 0
1707 L	22 0	33 0	4 0	6 5	12 0	11 5	18 5	21 0	4 0 × 12 5	25	Low —	13 5
1339 R	23 0	34 5	3 5	6 5	10 5	13 0	15 0	18 0	6 0 × 8 0	30	High ○	2 0
1339 L	23 0	35 0	3 5	7 0	11 0	13 0	20 5	20 0	6 0 × 8 0	25	Low —	7 0
695 R	29 0	37 0	3 0	9 0	14 0	8 5	15 5	24 0	1 0 × 1 0	20	High ○	10 0
695 L	27 0	35 0	4 0	9 0	11 5	9 5	14 0	22 0	1 0 × 2 0	45	High ○	11 0
Maximum	29 0	38 0	6 0	11 0	17 0	17 5	24 0	24 0				17 0
Minimum	19 0	27 5	2 5	6 0	10 0	8 5	13 0	13 5				2 0
Average	23 9	33 5	4 0	8 2	12 4	13 7	17 5	19 5				12 1

\* All measurements are recorded in millimeters Any angle listed in column J as 20 degrees measured 20 degrees or less The sign ○ is used in column K to indicate roundness of the jugular fossa and the sign — to indicate flatness

TABLE 19—Group III from Table 16, with Individual Data Listed \*

Specimen	A	B	C	D	E	F	G	H	I	J	K	L
1140 L	29 0	34 5	3 0	8 0	15 0	13 0	24 5	23 0	40 × 50	40	Low —	16 5
563 R	23 0	31 5	3 0	8 0	11 0	15 0	15 0	17 0	10 × 20	35	High ○	15 0
563 L	22 0	33 5	4 0	6 0	12 0	11 0	19 5	16 5	10 × 30	40	Medium —	13 5
548 L	23 5	35 0	5 0	8 0	12 0	12 5	22 0	21 5	10 × 60	25	Low —	17 0
588 L	26 0	31 0	3 0	9 0	15 0	11 0	20 0	20 0	50 × 70	20	Low —	8 0
934 R	24 0	36 5	3 0	6 0	11 0	14 0	17 0	17 5	60 × 120	35	High —	10 0
1109 R	20 0	34 0	2 5	6 0	10 5	12 0	18 0	16 0	50 × 110	60	Medium —	13 0
1109 L	21 0	34 0	3 0	6 0	13 0	13 0	20 0	17 0	60 × 160	60	Medium —	12 0
576 R	26 0	32 0	4 5	8 5	13 0	12 5	21 0	23 5	40 × 60	20	Low —	13 0
576 L	26 0	32 5	3 5	9 5	12 5	14 0	14 0	19 0	30 × 80	20	High ○	12 0
410 R	24 0	36 0	4 0	8 0	14 0	11 0	20 0	19 0	50 × 110	45	Low —	12 0
410 L	26 0	35 0	3 0	8 0	13 0	12 5	13 0	21 0	130 × 50	40	High ○	12 0
2558 R	23 0	35 0	4 0	6 0	16 0	12 0	20 0	20 0	90 × 50	50	High ○	15 0
2558 L	24 0	35 0	5 0	6 0	16 0	13 0	21 5	17 0	40 × 60	50	Low —	20 0
834 L	27 0	31 5	4 0	9 5	11 5	13 5	17 0	18 0	50 × 60	50	Medium —	15 0
2796 L	26 0	32 0	4 5	10 5	15 0	14 0	23 0	20 5	120 × 50	40	Low —	15 0
721 R	26 0	37 0	4 5	9 0	13 5	13 5	22 0	21 0	40 × 60	40	Low —	17 0
721 L	27 0	31 5	4 0	9 0	14 0	12 0	15 0	18 0	90 × 40	20	High ○	17 0
Maximum	29 0	38 0	5 0	10 5	16 0	15 0	24 5	23 5				20 0
Minimum	20 0	31 0	2 5	6 0	10 5	11 0	13 0	16 0				8 0
Average	24 6	34 1	3 9	7 8	13 2	12 8	19 0	19 2				14 0

\* All measurements are recorded in millimeters. Any angle listed in column J as 20 degrees measured 20 degrees or less. The sign ○ is used in column K to indicate roundness of the jugular fossa and the sign — to indicate flatness.

TABLE 20—Group IV from Table 16, with Individual Data Listed \*

Specimen	A	B	C	D	E	F	G	H	I	J	K	L
639 R	27 0	31 0	8 0	9 0	18 0	17 0	26 0	23 0	50 × 50	20	Low —	20 0
639 L	28 0	30 0	7 5	11 0	17 5	17 0	25 5	25 0	60 × 60	40	Low —	19 0
588 R	27 0	33 0	4 0	8 5	16 0	13 0	24 0	17 0	50 × 80	20	Low —	11 0
955 L	24 0	33 0	6 0	7 0	12 0	14 0	21 0	16 0	40 × 40	40	Low —	15 0
964 L	23 0	33 0	4 0	6 0	16 0	12 0	15 0	17 0	120 × 60	35	High ○	11 0
1012 R	25 0	29 5	4 5	11 0	12 5	16 0	13 0	19 0	10 × 60	45	High —	13 0
1012 L	25 0	30 0	4 5	9 0	12 0	17 0	18 0	18 5	30 × 40	45	High ○	16 0
1097 R	23 0	36 0	3 5	9 0	14 0	14 0	16 0	15 5	40 × 60	20	High ○	14 0
1097 L	24 0	34 5	4 0	10 5	13 0	12 0	20 0	16 0	30 × 60	20	Medium —	14 5
2104 R	24 0	26 0	4 0	9 5	10 0	13 5	16 0	19 0	45 × 40	60	Medium —	12 0
2104 L	21 0	26 0	4 0	8 5	12 0	13 0	20 0	21 0	40 × 60	65	Low —	12 0
1232 R	25 0	33 0	4 0	11 0	13 5	16 0	19 0	22 0	0	20	Medium —	19 0
1232 L	28 0	33 0	4 0	9 5	15 0	16 5	17 0	21 0	0	20	Medium —	14 0
519 R	24 0	31 0	5 5	12 0	14 0	15 0	17 5	21 0	10 × 40	30	High ○	21 0
519 L	25 0	30 5	6 5	11 5	15 0	16 0	16 0	20 0	80 × 50	45	High ○	15 0
854 R	27 0	29 5	3 0	9 0	12 0	11 0	19 5	20 0	30 × 40	50	Low ○	17 0
527 R	22 0	29 0	4 5	9 5	12 0	10 5	21 0	20 0	50 × 100	20	Medium ○	12 0
527 L	21 0	27 5	4 0	11 0	12 5	10 0	20 0	21 5	60 × 100	45	Low —	18 0
807 R	26 0	31 0	5 5	9 5	13 0	15 0	23 0	24 0	10 × 10	30	Low —	10 0
807 L	25 0	34 0	6 0	9 0	13 0	14 5	15 0	20 0	40 × 90	40	High ○	10 0
955 R	23 0	31 0	4 0	8 0	12 0	15 0	19 0	16 5	40 × 110	45	Low —	17 0
548 R	24 0	37 0	4 5	9 0	11 5	13 5	13 0	17 5	10 × 30	25	High ○	16 0
Maximum	28 0	37 0	8 0	12 0	18 0	17 0	26 0	25 0				21 0
Minimum	21 0	26 0	3 0	6 0	10 0	10 0	13 0	16 0				10 0
Average	24 6	31 3	4 8	9 5	13 5	14 2	18 7	19 6				14 8

\* All measurements are recorded in millimeters. Any angle listed in column I as 20 degrees measured 20 degrees or less. The sign ○ is used in column K to indicate roundness of the jugular fossa and the sign — to indicate flatness.

pneumatization, there are no racial distinctions. There were 78 specimens in the series representing the ages from 16 to 20. Though it falls short of the conventional biologic sample of 100, it is the largest series of specimens of which the case histories are known that has been available so far for a scientific study of adolescents. Among these 78 bones (no racial discrimination being made), 22 belong to group IV. It is remarkable that the percentage of bones showing apical pneumatization

TABLE 21—*Adult Material (378 bones) Divided into Groups I-IV with Average Measurements and Number of Cases of Each Series Listed\**

	No of Cases	A	B	C	D	E	F	G	H	L
Group I										
55 to 65 yr, men	15	24.0	33.0	3.6	7.7	13.5	12.0	17.2	19.2	11.5
20 to 30 yr, white men	11	23.0	33.5	3.6	7.2	12.7	10.7	16.4	18.2	11.7
20 to 30 yr, Negro men	11	20.4	34.9	3.2	7.0	11.2	12.5	15.2	16.7	7.3
16 to 20 yr	6	20.8	33.6	4.1	7.6	12.6	12.9	17.5	17.6	12.5
Group II										
55 to 65 yr, men	56	23.7	33.3	3.1	7.4	13.2	12.0	17.6	18.6	13.9
20 to 30 yr, white men	64	22.8	35.0	3.5	7.4	13.6	11.2	18.1	18.2	13.9
20 to 30 yr, Negro men	43	22.9	35.2	3.9	7.8	12.5	13.3	18.0	19.0	11.9
16 to 20 yr	32	23.9	33.5	4.0	8.2	12.4	13.7	17.5	19.5	12.1
Group III										
55 to 65 yr, men	21	25.8	34.3	3.8	8.1	13.8	13.3	18.8	18.9	16.0
20 to 30 yr, white men	14	24.6	35.5	3.5	8.0	13.1	13.1	19.0	19.1	17.5
20 to 30 yr, Negro men	35	24.8	35.3	4.7	8.4	13.6	14.3	19.3	17.7	15.3
16 to 20 yr	18	24.6	34.1	3.9	7.8	13.2	12.8	19.0	19.2	14.0
Group IV										
55 to 65 yr, men	8	26.2	32.8	3.5	9.3	14.8	13.7	16.6	20.0	16.8
20 to 30 yr, white men	11	24.5	34.8	4.3	7.6	14.5	13.2	21.6	18.6	16.2
20 to 30 yr, Negro men	11	24.9	34.7	4.1	9.6	13.4	13.5	19.5	18.9	15.3
16 to 20 yr	22	24.6	31.3	4.8	9.5	13.5	14.2	18.7	19.6	14.8

\* All measurements are recorded in millimeters

TABLE 22—*Weighted Averages of Adult Material\**

	No of Cases	A	B	C	D	E	F	G	H	L
Group I	43	22.42	33.71	3.59	7.37	12.58	11.93	16.33	18.06	10.62
Group II	195	23.27	34.31	3.56	7.61	13.03	12.29	17.86	18.71	13.26
Group III	88	25.03	34.83	4.11	8.15	13.50	13.54	19.11	18.52	15.56
Group IV	52	24.90	33.01	4.36	9.09	13.88	13.75	19.20	19.29	15.52

\* All measurements are recorded in millimeters

should be so large in this sample. There is not even any significant difference in morphologic features from the two previously described series.

The 378 adult temporal bones classified in tables 1, 6, 11 and 16 comprise a total of 43 specimens in group I, 195 specimens in group II, 88 specimens in group III and 52 specimens in group IV. The computed averages for the morphologic features presented by each group in each series are collectively arranged in table 21. The weighted aver-

ages appear in table 22. From these tables (21 and 22) the various morphologic features can be compared. Measurement A is greater in group IV than in group I (pneumatic vs arrested development). Measurement D is slightly greater in bones with pneumatic than in those with arrested development, as is measurement F. Measurement L differs more markedly between groups I and IV than does any other feature, this difference is in accordance with Wittmaack's views.

TABLE 23—*Bones of Children Under 16 Years of Age*

Maturation Age	Specimen	Phase of Pneumatization	Maturation Age	Specimen	Phase of Pneumatization
7 fetal mo	1885 R & L	I	6 mo	2468 R & L	I
7 fetal mo	2472 R & L	I	6 mo	1148 R & L	I
7 fetal mo	2431 R & L	I	6 mo	2031 R & L	I
7 fetal mo	2271 R & L	I	1 yr	1168 R & L	I
7 fetal mo	2201 R & L	I	1 yr	2075 R & L	II
7 fetal mo	1919 R & L	I	1 yr 1 mo	2017 R & L	II
7 fetal mo	1465 R & L	I	1 yr 1 mo	1950 R & L	II
8 fetal mo	1845 R & L	I	1 yr 4 mo	1435 R & L	I
8 fetal mo	2149 R & L	I	1 yr 7 mo	1355 R & L	II
8 fetal mo	1620 R & L	I	Under 2 yr	829 R & L	I
8 fetal mo	2119 R & L	I	2 yr	2322 R & L	II
8 fetal mo	1689 R & L	I	2 yr 7 mo	1557 R & L	I
8 fetal mo	2134 R & L	I	3 yr 11 mo	1115 R & L	II
9 fetal mo	2455 R & L	I	4 yr 8 mo	2240 R & L	II
9 fetal mo	2183 R & L	I	5 yr 5 mo	2144 R & L	I
9 fetal mo	1884 R & L	I	5 yr 8 mo	1074 R & L	III
9 fetal mo	2349 R & L	I	6 yr 1 mo	624 R & L	III
9 fetal mo	2436 R & L	I	6 yr 4 mo	1784 R & L	I
Less than 1 mo	2396 R & L	I	6 yr 6 mo	1098 R & L	I
Less than 1 mo	273 R & L	I	6 yr 9 mo	632 R & L	III
1 mo	1462 R & L	I	6 yr 9 mo	1156 R & L	II
1 mo	278 R & L	I	7 yr 5 mo	2074 R & L	II
1 mo	240 R & L	I	8 yr 11 mo	1834 R	II
1 mo	232 R & L	I	8 yr 11 mo	1834 L	I
1 mo	1432 R & L	I	9 yr 4 mo	526 R & L	III
2 mo	2302 R & L	I	9 yr 6 mo	2036 R & L	II
2 mo	1700 R & L	I	9 yr 8 mo	872 R & L	III
2½ mo	293 R & L	I	10 yr 3 mo	1688 R & L	I
2½ mo	2124 R & L	I	10 yr 6 mo	404 R & L	III
2½ mo	230 R & L	I	11 yr 1 mo	710 R & L	II
3 mo	816 R & L	I	11 yr 10 mo	1441 R & L	II
4 mo	818 R & L	I	11 yr 11 mo	1772 R & L	II
4 mo	2247 R & L	I	12 yr 9 mo	633 R & L	II
5 mo	1619 R & L	I	13 yr 8 mo	1240 R & L	III
5½ mo	1453 R & L	I	15 yr	1041 R & L	III

Total number of bones in each group I, 93, II, 29, III, 16, IV, 0

No inference can be made from the angle of the posterior root of the zygoma in predicting the proximity of the lateral sinus to the depression of Wilde (or for practical purposes, to the posterior wall of the external auditory canal). If the reader will refer to tables 2, 3, 4, 5, 7, 8, 9, 10, 12, 13, 14, 15, 17, 18, 19 and 20, he will notice that there is no constant relation between arrest or nonarrest of pneumatization and the size of the angle. Therefore, the independence of the form of the posterior root of the zygoma from all other bony features must be emphasized.



A bony dehiscence was found to exist between the canal for the carotid artery and the tympanic cavity (anterior part) in specimens 1013 R and 1203 R (series representing ages 55 to 65). A bony dehiscence was found also in the wall between the jugular fossa and the tympanic cavity (inferior part) in specimens 1280 R, 554 R, 554 L (series representing ages 55 to 65), 1312 L and 1361 L (series of 20 to 30 year old Negro men). A dehiscence was found between the jugular fossa and the posterior cranial fossa high up near the internal auditory meatus in specimens 899 R, 912 R, 1872 R, 797 R (series representing ages 55 to 65), 695 R, 548 R, 519 R (series representing ages 16 to 20), 436 R and 618 R (series of 20 to 30 year old white men). It has no real bearing on the foregoing discussion, but it is interesting to note that of 378 temporal bones 2 were found with a dehiscence in the carotid-tympanic wall, 5 with a dehiscence in the jugular-tympanic wall and 9 with a dehiscence between the jugular and the posterior cranial fossa.

Table 23 lists the 138 temporal bones of children under 16 years maturation age. It was from this series that the standard of development based on pneumatization was selected. It is observed that 93 bones appear in group I, 29 in group II, 16 in group III and none in group IV. It is noted also that the third phase is already reached in this series by the skull of a 5 year 8 month old child. It is sure, therefore, that the third phase can be reached by the sixth birthday. Wilson, Gaardsmoe and Anson,<sup>11</sup> working in the department of anatomy of Northwestern University, found (by the method of Boin) that pneumatization had extended in full adult degree throughout the apex in a 4½ year old child. They also mentioned that the marrow spaces were separated from the pneumatic spaces by a plate of bone as thick as the inner table of the petrosa (presumably of the same bone). In this study it has not been possible to detect by roentgenographic examination the presence of pneumatic spaces in the apexes of the pyramids of these 138 bones of children of maturation ages 7 fetal months to 16 years.

In these bones of younger persons, in which the cells are small, the pneumatic spaces cannot be distinguished from the medullar spaces (referring to the apexes) for the very reason that the cells are small, but later, when they have become ballooned and larger, the spaces can be differentiated. Therefore the essential feature is the ballooning of the pneumatic cells, which seems to take place characteristically, but not invariably, later in childhood or more particularly in early ado-

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11 Wilson, J. G., Gaardsmoe, J. P., and Anson, B. J. The Air Cells of the Petrous Portion of the Temporal Bone, *J. Laryng. & Otol.* 52: 746, 1937.

lescence, and marks the transition from the third to the fourth phase. I have at present no satisfactory explanation of the high percentage of pneumatic bones in the series of adolescents. In the series of bones from children, after the first birthday specimens representing the first phase become suddenly infrequent. Specimens representing the second phase can be found after the first birthday, and the third phase, after the sixth birthday. No example of the fourth phase occurs until after the sixteenth birthday, though it may occur, as Wilson, Gaardsmoe and Anson have shown, as early as the third phase appears in the present series.

#### CONCLUSIONS

1 The findings recounted in this study support the theory of pneumatization formulated by Wittmaack.<sup>2</sup>

2 If Wittmaack's theory of pneumatization is extended to include the apical or carotid portion of the pyramid, there is a lowering of the frequency of normal pneumatization.

3 The earliest age at which pneumatization could be definitely detected in the carotid portion of the pyramid by roentgenographic study was 16 years, but that pneumatization has already begun in younger childhood is evident from the study by Wilson, Gaardsmoe and Anson.<sup>11</sup>

4 Roentgenographic classification of pneumatization of the temporal bone follows a definite schedule, so that bones may be classified as follows:

Group I Pneumatization arrested at or before birth

Group II Pneumatization arrested at about the 2 year phase

Group III Pneumatization arrested only in that the apex or carotid portion is not pneumatic

Group IV Pneumatization extending into the petrous apex in addition to the other areas specified in the text

5 Wittmaack's explanation for arrested pneumatization of the mastoid portion depends on changes in the mucous membrane of the middle ear and its outpocketings occurring in the first and second year of life. The apex or carotid portion of the pyramid is now added to the areas subject to normal pneumatization and the period of outpocketing is extended through childhood to adolescence.

6 The earlier the arrest of pneumatization occurs, the closer will be the lateral sinus to the depression of Wilde (or, for more practical purposes, to the posterior wall of the external auditory canal).

7 In the adult specimens (378), mensural differences depend on features of growth and on the factor of pneumatization. Race seems to make no difference.

8 In general, the most extensively pneumatized bones have greater morphologic measurements, accordingly, their volume is greater.

9 In all, 536 temporal bones have been studied, pneumatization in the apical or carotid portion of the pyramid is first roentgenologically detectable after the age of 16 is reached. Of the 378 bones derived from adults, persons over 16, 52 showed pneumatization in the apex. The several series show pneumatic apices in percentages which compare favorably with those reported by other authors. Marked differences may occur on the two sides of the same skull, as in the example cited in the text in which the right side belonged to group I and the left to group IV. As a rule, however, such differences were less pronounced, being limited to successive groups, such as I and II, II and III or III and IV.

10 In no bone was there found a pneumatic apex with a complete arrest in the external and mastoid portions of the pyramid. It may be concluded, therefore, that the mucous membrane of the middle ear behaves as a unit.

11 A roentgen technic especially suitable for children up to 5 or 6 years of age is presented in the text. The principle is the following: The pyramid is viewed perpendicularly to its longitudinal axis, and in this early period of life pneumatization extends along the axis of the pyramid. A good view of the cavity of the middle ear also is obtained in this position.

12 The roentgenographic study of 20 temporal bones before and after maceration shows no roentgenographically distinguishable features. It must therefore be admitted that the roentgenogram cannot differentiate marrow cells from pneumatic cells, save that the latter, being ballooned, are differentiable in outline.

13 Various landmarks of common surgical use have been used in this study.

14 Morphologic data on 378 adult temporal bones are recorded in tabular form for reference.

15 Morphologic differences in the temporal bone are due to developmental growth and to pneumatic factors. Once the adult stage is reached differences in certain areas (e. g. dimension B) are negligible no matter what the stage of pneumatization may be, but in certain areas (dimension L) the stage of pneumatization may cause definite variations.

16 A temporal bone may show any gradation of pneumatization from none at all to complete in any or all parts of the pyramid. Since

the apical or carotid part of the pyramid does not begin to become pneumatized until after the second phase has been reached, the relative frequency of apical pneumatization is already limited by those factors which arrest pneumatization in the other parts of the bone

17 It is desired to emphasize particularly the significant influence which growth, maturation, time and disease have already had on the temporal bone before it is submitted to the clinician for his judgment and operative measures

## Case Reports

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### MEDIASTINAL ABSCESS FOLLOWING TONSILLECTOMY

G EDWARD TRFMBIE, M D, AND P HEWITT, M D, MONTREAL, CANADA

The extreme rarity of mediastinal abscess is considered sufficient reason to report the following case

In a review of the admissions to the Royal Victoria Hospital for the past fifteen years, only 2 cases of mediastinal abscess were found recorded in the surgical wards. This is the first time the complication followed tonsillectomy and a definite diagnosis was made by means of the roentgen apparatus

The patient had been carefully examined just prior to admission to the hospital and again on admission. Nothing abnormal was found on either occasion, except that on the morning of the operation the patient complained of a slight cold in the head. This was not deemed severe enough to warrant postponing the operation, as the temperature was normal. The only significant factor in the history was that she occasionally complained of an indefinite pain beneath the sternum and in the lower dorsal region.

The patient was taken to the operating room but, contrary to the usual procedure, avertin with amylene hydrate and gas were administered at the patient's request. There was little bleeding during the operation, and she was returned to her room within half an hour, in good condition.

The patient could not be aroused until 4 30 p m, and at this time she complained of pain in the back and was irritable and restless. During the night she rested poorly and constantly complained of pain in the lower dorsal region. The temperature rose to 101.2 F and for the next fourteen days ranged from 100 to 103.2 F, following a septic course. The pulse rate varied from 100 to 130, and the respiratory rate, from 20 to 30.

She was seen on the following day by Dr S Lewis, who thought, from the symptoms, that she had a partial collapse of the right lung. This was not borne out by physical findings or by roentgen examination.

During the next five days she complained of pain in the lower dorsal region and under the sternum. She also complained, at times, of pain in the knees, ankles, elbows, shoulders and wrists. On numerous occasions she had "chilly" sensations which were followed by a rise in temperature, she would then perspire freely and the temperature would fall.

During the first five days she had no nausea or vomiting, but on the morning of the sixth day she complained of feeling nauseated, and shortly after this she vomited what at first was thought to be grape juice. This was repeated several times during the day, the vomitus becoming lighter in color each time until finally it was creamy white. On examination under the microscope it was found to be pus. Microscopic examination of the pus revealed a mucopurulent material containing

large numbers of polymorphonuclear cells and a wide variety of organisms many gram-positive cocci in irregular clusters and some gram-positive cocci in chains, many rather large spirochetes and many gram-positive rods, most of which resembled acidophils. Two acid-fast and alcohol-fast rods were found. Cultures revealed the usual organisms of the throat and also pneumococci that were not of type I, type II or type III. These organisms were injected into 2 guinea pigs, 1 died at the end of six weeks, and the other was killed at the end of three months. No evidence of tuberculosis was found in either of the animals at autopsy. The culture showed no growth of tubercle bacilli.



Roentgenogram taken after ingestion of a barium meal. The upper arrow indicates the passage of the barium into the mediastinum. The lower arrow indicates the presence of the barium in the esophagus.

Each day the patient vomited from two to five times, the amount of pus varying from 15 to 150 cc.

Repeated examination of the chest and roentgen examinations revealed nothing. Finally, on the thirteenth day after the operation, the patient was taken to the x-ray room at the suggestion of Dr. Archibald. Barium sulfate was given by mouth and she was examined fluoroscopically. This examination disclosed a fistula extending from 2 inches (5 cm) below the cricoid cartilage into the mediastinum. The report stated: "The barium sulfate passed slowly through the

esophagus, which was irregularly stained about 2 inches below the cricoid cartilage. From this point an irregular stream passed backward and downward into the mediastinal spaces."

Postural drainage was then instituted, with good results. The temperature became normal on the fifteenth day and remained so. The amount of pus expectorated steadily diminished, and on the thirty-sixth day the patient was taken to the x-ray room again, barium sulfate was given by mouth for fluoroscopic examination. It was found that the mixture no longer entered the mediastinum. During this time the white blood cell count ranged from 10,000 to 14,500. The treatment throughout was conservative. The fluid supply was maintained by intravenous injections and rectal instillations of dextrose. Later, sterile fluids were given by mouth without ill effect.

Three months after the patient's discharge from the hospital she was examined and found to be in normal health.

## PHARYNGEAL LYMPHOBLASTOMA SIMULATING RETROPHARYNGEAL ABSCESS

LOUIS BLUMENFELD, M D , AND MILTON D GOLDFEIN, M D , BROOKLYN

While the pathologic entity of pharyngeal lymphoblastoma is not rare and there should not be any unusual difficulty in making a diagnosis in the average case, the symptoms presented by our patient for a time so masked the picture that several diagnoses were discussed. It was not until surgical intervention, with removal of a section for pathologic study, that the diagnosis became evident.

Lymphoblastoma is commonly referred to as lymphosarcoma. However, some authorities like to make a distinction between the two. To quote Delafield and Prudden <sup>1</sup>

There may occur in any part of the lymphatic system a tumor composed of lymphocytes (*lymphocytoma*) or, more generally, of their ancestral element, the lymphoblast (*lymphoblastoma*). This type of growth is often called a *lymphosarcoma*, but as there is an increasing desire on the part of pathologists to preserve the term sarcoma for neoplasms of supporting connective tissue, *lymphoblastoma* has been suggested as a substitute.

The parenchyma of an affected node is entirely destroyed, its follicles and lymph cords being no longer recognizable, while the capsule and surrounding tissues are densely infiltrated by tumor cells, elements resembling in size, shape, and appearance the large mononuclear leucocyte.

Along the same line, Ewing <sup>2</sup> said

Primary pharyngeal lymphosarcoma is a very common type, and the fact, that with the cervical forms they constitute the majority of the cases, suggests that an infectious agent commonly enters through this area (Chiari, Lit). The initial symptom is a swelling of lymphoid tissue and diffuse infiltration of mucosa of tonsillar ring or pharyngeal wall, and the early appearances are characteristic (Kundrat). According to Eisenmenger the process regularly begins in the pharyngeal mucosa and not in the tonsils. Yet in several cases at the Memorial Hospital the disease was recognized shortly after removal of enlarged tonsils. Ulceration is soon established, and remains a persistent or recurring complication.

Ewing further stated <sup>3</sup>

Lymphosarcoma, representing a lawless proliferation of reticulum cells and their derivatives, may be attributed, *a priori*, to any irritant which influences these unstable cells over a considerable period or in a specific manner. There is no

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From the otolaryngologic service of Dr. E. L. Berger, at the Jewish Hospital.

1 Delafield, F., and Prudden, T. M. Textbook of Pathology, ed 16, Baltimore, William Wood & Company, 1936.

2 Ewing, J. Neoplastic Diseases. A Treatise on Tumors, ed 3, Philadelphia, W. B. Saunders Company, 1928, p 417.

3 Ewing, <sup>2</sup> p 420.



urgent necessity for assuming the existence of any unknown microorganism or any other occult factors in the origin of this process, for when the above principle is applied in the study of cases a large proportion of lymphosarcomas are reasonably accounted for

#### REPORT OF CASE

A 12 year old boy, referred to the office of one of us (M G) on June 22, 1936, had been sent home from school with a heavy "cold in the head" two weeks previously. Two days before he was brought to the office, he had begun to complain of pain on swallowing, his speech had become nasal, and a swelling had appeared in the cervical region on the left side.

When seen the child did not appear ill. He had no fever. He was breathing through his mouth and showed definite signs of nasal obstruction.

*Examination*—The throat showed a swelling in the left parapharyngeal and retropharyngeal space at the level of the tonsil. The tumor was soft and fluctuant to the touch. The mucous membrane did not seem especially inflamed. There was a postnasal discharge. Both nares were filled with a mucopurulent material, but after suction no definite signs of an acute sinusal infection were visible. Transillumination showed the sinuses to be normal. Externally, in the cervical and submaxillary regions there was a hard and somewhat tender mass of glands, which showed no adherence to the skin. The impression obtained at the time was of a retropharyngeal abscess. The soft mass within the throat was incised, but no pus was obtained. As examination of the patient twenty-four hours later showed no change in the pathologic picture, he was advised to go to the hospital for further study.

On June 24 the patient was admitted to the service of Dr. E. L. Berger at the Jewish Hospital in Brooklyn. Dr. Berger reported his examination as follows: "There is a large mass in the cervical region which is tender and hard but not adherent to the underlying skin. The throat reveals a parapharyngeal mass on the left side extending into the epipharynx. There is evidence of a recent incision, through which protrudes some necrotic material."

The temperature, pulse and respiration were normal. The laboratory reported 4,300,000 red blood cells, 11,200 white blood cells, 67 per cent polymorphonuclears and 80 per cent hemoglobin. Cultures of material from the throat were negative. The roentgenograms showed broadening of the retrolaryngeal and retropharyngeal spaces, with straightening of the cervical part of the spine. These conditions suggest a retrolaryngeal and retropharyngeal bulge such as is commonly due to adenitis or abscess.

*Course*—A tentative diagnosis of low grade pharyngeal infection and adenitis without suppuration was made and expectant treatment instituted. The mass, both internally and externally, became progressively larger without evidence of any fluctuation. On July 7, fourteen days after admission of the patient to the hospital, we decided, with the thought that we might obtain pus, to incise this mass. On incision, however, no pus was found. That night the patient began to be dyspneic, and at midnight an emergency tracheotomy was necessary. After this procedure he began to show improvement and the external swelling as well as the mass in the throat became smaller. Four days after the operation the patient was so much better that the tracheotomy tube was removed. The next day adhesive tape was placed over the tracheotomy wound in an effort to close

the incision. The patient remained fairly comfortable until July 17, when we were forced to replace the tracheotomy tube because of increasing dyspnea. The mass in the throat again became larger and soon extended past the midline. The cervical mass also increased in size. Throughout this period the patient's general condition was good, his blood was normal and no other glands were enlarged.

On July 21 a section of the pharyngeal growth and two glands were removed for microscopic study. Without waiting for the pathologic report, we instituted roentgen-ray therapy on the assumption that we were probably dealing with a

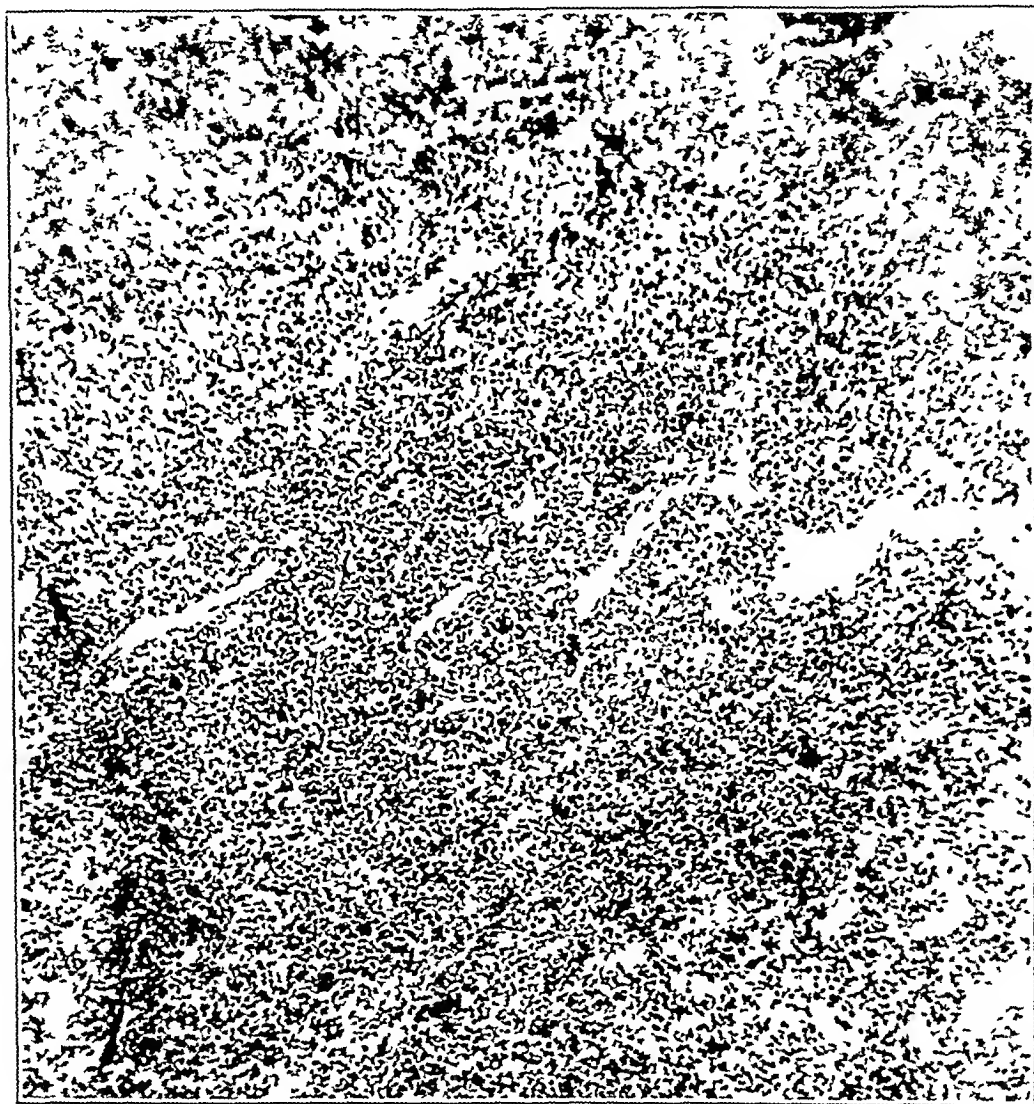


Fig 1—Photomicrograph ( $\times 200$ ) of a section of the pharyngeal growth showing the general topography of the tumor.

new growth involving the lymphatic system. Daily studies of the blood showed nothing abnormal.

On July 27 the patient began to bleed from the nasopharynx. The bleeding grew progressively worse in spite of all attempts to control it. After two days he received 350 cc of blood given by the direct method. The oozing continued. On July 31 the patient was taken to the operating room for ligation of the external carotid artery to control the bleeding. The tumor mass so involved the

carotid sheath and its vessels that it was impossible to expose the artery. He died that night.

*Laboratory Report*—Gross examination of the section that had been removed revealed a specimen consisting of two firm portions of tissue, measuring 1 by 0.5 by 0.4 cm and 1.5 by 1 by 0.7 cm, said to be a lymph node. The external surface was smooth and bore several tags of fibrous tissue. The cut surfaces were composed of gray tissue, in which some red areas were embedded.

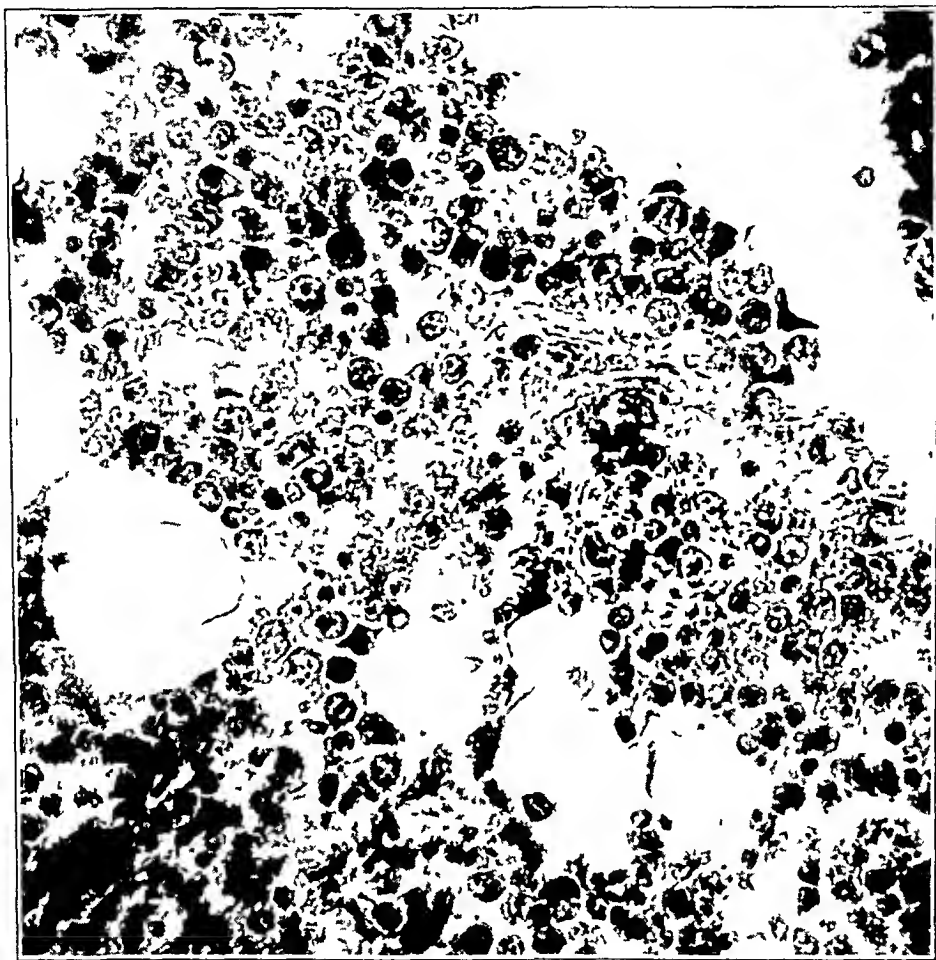


Fig 2—Photomicrograph ( $\times 500$ ) of a section of the tumor under high magnification, showing the round cells, with vesicular deep-staining nuclei, scant cytoplasm and indistinct borders.

When a longitudinal section through each portion of tissue was taken for microscopic study, the structure of the lymph node was seen to be distorted by an infiltration of small round cells having large vesicular nuclei and a narrow rim of cytoplasm with indistinct borders (figs 1 and 2). The sinusoids elsewhere and the subcapsular sinusoids were infiltrated, and the cellular infiltration extended into the nearby adipose tissue, leaving large groups of adipose tissue cells (fig 3). In the periphery here and there was an infiltration of freshly

extravasated blood and some polymorphonuclear leukocytes, with their nuclear fragments. In another preparation a diffuse infiltration with cells having deep-staining nuclei was more noticeable, the cells appeared in groups and filling sinusoids. A compression of the peripheral cells near the germinal centers was seen. The nuclei of the infiltrating cells appeared to be somewhat larger than the nucleus of a lymphocyte but smaller than that of lymphoblast. In a third preparation the architectural outlines of the lymph node were partly preserved, the distortion being comparatively slight. The germinal centers were active and the sinusoids con-



Fig 3—Photomicrograph ( $\times 200$ ) showing the invasion of the adipose tissue by the tumor

tained deep-staining cells and some red blood cells. The cellular infiltration extended beyond the capsule at some points. Preparations stained by the May-Grunwald method gave no additional information. The nuclei of the infiltrating cells were deep staining. Nuclei in a state of mitotic division were few. The infiltrative character was evident by the passage of the cells beyond the borders of the node and by the infiltration of the nearby adipose tissue.

*Diagnosis*—The final diagnosis was lymphoblastoma.

## COMMENT

From this case we learned that the usual symptoms referable to the upper part of the respiratory tract may be the forerunner of an unusual underlying pathologic condition. The acute onset, the age of the patient and the symptoms were entirely misleading. We therefore suggest that when a physician is confronted by a definite chain of symptoms indicative of a common disease he should bear in mind the unusual conditions that may cause the same group of symptoms.

1564 St. Marks Avenue  
866 Prospect Place

# Clinical Notes

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## AN ACCURATE METHOD OF DESCRIBING THE COLOR OF MUCOUS MEMBRANE

E R HARGETT, M D, SPRINGFIELD, OHIO

At present there is no universally accepted scale in use for the description of the color of mucous membrane, especially of the fine variations that occur in the nasal and turbinate membranes. In fact, most writers are content to picture shades of nasal and of pharyngeal membrane according to their own ideas of the tones of red, or they describe them merely as acid or basic in appearance.

I suggest the general adoption of the Tallqvist hemoglobin scale, with the addition of zero (0) per cent, or intensity, for the description of polyps. The marked change from an intensity of 50 to one of 40 on this scale could well be understood to mark the transition of an acid-appearing membrane, at 50, to one with a basic reaction, at 40.

With such an improved method of determining color, it would be possible for a reader anywhere immediately to note the exact shade the writer had in mind by merely looking at his own easily obtained Tallqvist scale. The method could be used to great advantage also in teaching and lecturing.

First National Bank Building

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## A NEW PURE TONE AUDIOMETER FOR SCHOOL USE

HORACE NEWHART, M D, MINNEAPOLIS

In presenting this new type of audiometer designed for a specific purpose I claim no credit for its technical development beyond the fact that early this year I pointed out to Mr R E Allison, the electroacoustic engineer of a company manufacturing a widely distributed audiometer for diagnostic use, that there exists a large potential demand for a simple, well constructed, pure tone audiometer which could be sold at a low price, especially designed for individually testing the hearing of large groups, particularly school children.

His response was surprisingly prompt. Within three weeks he produced this instrument, known as the maico D-6 school audiometer.

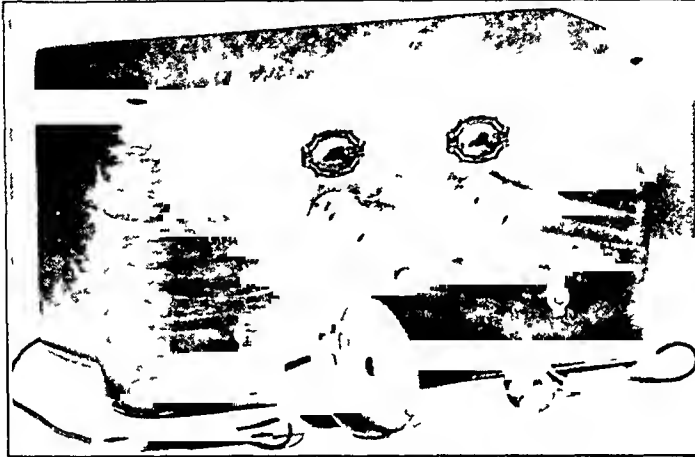
It is a pure tone audiometer with a high grade dynamic receiver. Its operating range is from 128 to 8192 cycles at fixed intervals of one octave with intensities variable in steps of 5 decibels (table).

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Presented at the Forty-Fourth Annual Meeting of the American Laryngological, Rhinological and Otological Society, Inc., Atlantic City, N J, April 29, 1938, at the Seventy-First Annual Meeting of the American Otological Society, Inc., Atlantic City, N J, May 6, 1938, and before the Section on Laryngology, Otology and Rhinology at the Eighty-Ninth Annual Session of the American Medical Association, San Francisco, June 17, 1938.

It is accurately calibrated and practically meets as nearly as other audiometers submitted the tentative minimum requirements for acceptable audiometers of the Council on Physical Therapy of the American Medical Association, so far as they have been formulated and are applicable to an instrument of this kind

It has a silent tone interrupter and push button signal light. Outstanding features are the uniform zero reference level and the illuminated, easily read intensity and frequency dials, which together make possible rapid, accurate operation. With it from 30 to 50 persons per hour, or from 150 to 250 per school day,



New maico D-6 school audiometer

*Range of Intensity of the New Pure Tone Audiometer*

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Test Tone (Cycles per Second)	Range of Intensity (Decibels)
128	70
256	80
512	100
1024	100
2048	100
4096	95
8192	80

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can be tested. It is operated by the 110 volt, 60 cycle electric current. Battery-operated models at some additional cost will be obtainable for use in rural schools in which commercial electric current is not available. These features and the low cost (\$130.00) make instruments of this type especially desirable for use in public schools and in the student health services of colleges and universities. They will also prove of great usefulness in public health work and in industrial medical practice.

The fact that they do not provide the means for testing by bone conduction and have no masking device precludes their use for diagnostic purposes or prescribing hearing devices. Thus there is avoided the temptation to the nurse or technician to encroach on the field of the practicing physician by making diagnoses.

One audiometer of this type has ample capacity for quickly 'screening' a school college or industrial group containing up to 4,000 or 5,000 persons at a minimum cost. Those found to have deficiency in hearing are rechecked to determine their exact loss of hearing. Although the technic is simple and the tests can be made by a nurse, a technician or a teacher, the work should be done under the supervision of a qualified medical practitioner.



# Progress in Otolaryngology

## Summaries of the Bibliographic Material Available in the Field of Otolaryngology

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### CHRONIC PROGRESSIVE DEAFNESS, INCLUDING OTOSCLEROSIS AND DISEASES OF THE INNER EAR

GEORGE E SHAMBAUGH JR, M D

CHICAGO

The literature for 1937 is unusual for the large number of contributions on nerve deafness. Especially noteworthy are an extensive article, amounting to a monograph, on traumatic nerve deafness by Bunch and a monograph on the pathology of senile deafness by H von Fieandt and Arno Saxén. The question of the etiology of otosclerosis receives somewhat less attention than usual, but two articles deal with experimental otosclerosis in the fowl with reference to Wittmaack's theory of the etiology of otosclerosis. There are important reports on the results of Gray's intratympanic treatment of otosclerosis with thyroxin as well as several articles on the surgical treatment.

Articles which are merely a repetition of previous work are not included in this summary. My editorial comments are in brackets. The material has been arranged according to the following outline:

#### Otosclerosis

Pathology and Etiology

Treatment

#### Labyrinthine Deafness

Pathology of Nerve Deafness

Hereditary Nerve Deafness

Traumatic Nerve Deafness

Nerve Deafness from Drugs

Nerve Deafness from Infections

Nerve Deafness from Allergy

Nerve Deafness from Miscellaneous Causes

Treatment of Nerve Deafness

Meniere's Syndrome

#### OTOSCLEROSIS

*Pathology and Etiology*—Nager<sup>1</sup> contributes an interesting discussion of the pathologic changes that occur in the labyrinthine capsule.

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<sup>1</sup> Nager, F. R. Disease of the Labyrinthine Capsule. The Pathological Changes, *Laryngoscope* **47** 161 (March) 1937.

In an attempt to throw light on the etiology of otosclerosis he has studied the effect on the labyrinthine capsule of all known diseases of bone

The labyrinthine capsule consists of three layers the endosteal, the endochondral and the periosteal. The endosteal layer is peculiar in that it does not show the constant processes of resorption and apposition seen in living bone elsewhere in the body whereas the periosteal layer does show these processes. The endochondral layer is characterized by the so-called interglobular spaces which are remains of its development from cartilage and which persist throughout life

In senile osteoporosis when resorption of bone is normal but apposition of new bone is deficient, the periphery (periosteal layer) of the petrous bone looks spongy, whereas the endochondral layer is not affected. The marrow spaces of the periosteal layer are large and filled with a fatty marrow. Rickets and osteomalacia also are observed only in the periosteal layer the endochondral and endosteal layers of the labyrinthine capsule remaining intact. On the other hand in osteolysis due to tumors of the eighth nerve or in carcinoma of the middle ear all layers of bone are destroyed but the endochondral layer seems to be most resistant

In suppuration of the middle ear the periosteal layer is easily destroyed whereas the endochondral layer shows a larger resistance. If inflammatory and necrotic processes start in the inner ear, all layers of bone may be destroyed, but it will be seen that when the inflammation heals the bony tissue does not resemble the old endochondral layer. The newly formed bone shows quite another structure so that later a differentiation between the cicatricial bone and the primary bone is possible. The hollow spaces of the inner ear are filled with bony tissue, as for instance in deafness after meningitis

Further evidence of the biologic characteristic of the endochondral layer is shown by the fact that fractures of the labyrinth do not heal because the endochondral layer cannot produce a bony tissue, consequently fractures through the labyrinth remain open, which is shown by roentgen examination and which moreover may be the cause of late meningitis

In Paget's disease the destruction and new formation of bone start from the periosteal layer. The whole capsule is reformed by unripe bony tissue the marrow is fibroblastic. In advanced stages even the endochondral layer will be affected in the same way but generally there remains some small portion of the capsule. It is known that in Paget's disease the stapedovestibular joint may be affected so that the syndrome of ankylosis of the stapes results

In von Recklinghausen's disease, with tumors of the parathyroid gland, only the periosteal layer is affected in the well known way of formation of fibroblastic bone marrow. This distinctly resembles otosclerotic tissue, and it may be difficult to differentiate the diseases in advanced stages.

In congenital disease of bone the labyrinthine capsule shows typical alterations. In a case of associated athyreosis (absence of the thyroid gland) the endochondral layer was normal but looked a little underdeveloped, ossification of the periosteal layer also was underdeveloped.

In chondrodystrophy, the ossification seems to be normal with the exception of the zones of ossification, they show the same alterations as are known in chondrodystrophy of the extremities.

In osteogenesis imperfecta (*fragilitas ossium*), the resorption of the cartilaginous tissue is known to be normal, whereas the formation of bone is deficient. This occurs especially in the vestibular part of the labyrinthine capsule, whereas the cochlea remains surrounded by a distinct thin layer of bone.

In endemic cretinism, which is known to be frequent in Alpine regions and which leads to dwarfism and other deformations of bone, the alterations of the petrous bone are so typical that even without knowing anything else about the case the diagnosis of this disease can be made from the ear. There is marked hyperostosis of the promontory, with narrowing of both window niches and certain malformations of the ossicles.

As to otosclerosis, the typical changes show that this disease is to be considered a local osteodystrophy, since the details of the alterations are similar to those in Paget's and von Recklinghausen's disease. The cause of this local osteodystrophy remains unknown.

Cinelli<sup>2</sup> reports the case of a man of 34 with chronic progressive deafness for ten years and a history of fractures 16 different times. His father and paternal grandfather had had many fractures and defective hearing. [Since no bone conduction tests were made, it is not possible to know from the author's report that this was a case of otosclerosis.]

Ramisch<sup>3</sup> tried the effects of epinephrine and pilocarpine in 105 cases of deafness of varying causation. In cases of impaired conduction of sound of the otosclerotic type epinephrine lowered the hearing. This lowering lasted as long as the other symptoms produced by the drug. In early stages of otosclerosis it was marked, in late stages, slight.

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2 Cinelli, A. A. *Fragilitas Ossium with Otosclerosis and Blue Sclera*. Report of a Case, *Arch Otolaryng* **25** 309 (March) 1937.

3 Ramisch, S. M. *Wirkung von vegetativen Giften auf Schwerhörige*, *Arch sovet otol*, 1937 no 3, p 64.

In other types of deafness this reaction did not occur. Pilocarpine led to an improvement in hearing in all forms of deafness. This improvement increased gradually up to 50 to 100 per cent toward the end of the first hour and lasted eight to twelve days, the hearing then returning to its former level, with a recurrence of the tinnitus. Repeated injections of pilocarpine led to an increase in hearing of the same duration. Menses somewhat lessened this effect of pilocarpine.

Schkljai and Drennowa<sup>4</sup> occluded the external auditory canal with a hollow tube ending in a capillary tube containing a drop of alcohol, so that movements of the drum membrane resulted in corresponding movements of the droplet of alcohol in the capillary tube. Normally when air is blown into the eustachian tube the outward and inward movements of the drum membrane are equally rapid. The return of the droplet to its initial position can be slowed by various causes. Thus in 86 per cent of patients with otosclerosis the return of the droplet is slowed by a loss of tonus in the drum membrane, probably the result of an insufficiency of the muscles of the middle ear.

Orlova<sup>5</sup> investigated the cholesterol content of the blood in 79 cases of otosclerosis, concluding that the cholesterol is diminished, especially in the early and intermediate stages. During menstruation and with age, there is usually an increase of cholesterol in the blood, so that in elderly patients with advanced otosclerosis an increase of cholesterol in the blood was often found. [Since Russian workers last year reported abnormal amounts of potassium, calcium, nitrogen, chlorides and choline in the blood in otosclerosis, whereas chemical studies of the blood elsewhere have given negative results in otosclerosis, there is some doubt about the value and significance of these Russian reports.]

Schlender<sup>6</sup> states that otosclerosis is rarely observed histologically in the first decade of life and is never seen clinically. Of the cases of otosclerosis in childhood thus far recognized, Manasse has described that of a 3½ year old boy, Weber of a 6 year old girl and of a 6 year old boy, Wittmaack of a 5 year old boy and Scheibe of a 9 year old boy. In each case there was no deafness, the lesion being recognized only on histologic examination.

The author's case is of a 9 year old girl who had had normal hearing except during an attack of acute otitis media on the right side complicated by thrombosis of the lateral sinus and the jugular bulb.

4 Schkljai, D. A., and Drennowa, K. A. Ohrmanometrie bei Otosklerose, Arch. sov. otol., 1937, no. 3, p. 31.

5 Orlova, E. F. Otosklerose und Blutcholesterin, Arch. sov. otol., 1937, no. 3, p. 48.

6 Schlender, E. Ein Fall von juveniler Otosklerose, Monatschr. f. Ohrenh., 71: 513 (May) 1937.

at the age of 4 years and during occasional attacks of secretory catarrh with head colds. The child died of meningitis following acute otitis media and petrositis of two days' duration. The right ear showed a small focus of otosclerosis at the anterior border of the oval window (site of predilection), and the left ear showed a larger focus in the same region. The footplate had not become involved, and the inner ear on each side was normal.

Altmann<sup>7</sup> sets himself the task of clarifying the question of experimental otosclerosis. He first reviews the previous investigations beginning with a history of the histologic knowledge of otosclerosis. Politzer first accurately described the pathologic picture of otosclerosis and maintained that it was a clinical entity by itself. The finer structure of otosclerotic bone was first studied by Siebenmann, who described (1899) the lacunar areas with osteoclasts and showed that the new bone was demarcated from the old labyrinthine capsule by a sharp, scalloped line, the so-called cement line. Manasse (1912) showed that dark blue-staining, spotted, nonlamellar new bone is first formed in the otosclerotic focus. This new bone is then absorbed by osteoclastic activity and is replaced by lamellar red-staining bone, which finally becomes compact. An explanation of the complicated structure of otosclerotic bone was first offered by O. Mayer (1917), who showed that the original blue-staining bone is repeatedly destroyed by osteoclasts and replaced again by similar bone, until gradually there is formed a maturer red-staining bone, which at first shows only a hint of lamellar structure and later becomes mature lamellar bone. This matured process can flare up and the new lamellar bone may again be replaced by immature blue-staining, spotted bone. By intermingling of these processes the extremely complicated and variable picture of the otosclerotic process occurs. Manasse (1922) then showed that outside the otosclerotic focus changes in the perivascular bone can be seen, consisting of the deposition of new blue-staining bone and called by him "blue mantles."

Concerning the etiology of otosclerosis, O. Mayer and Manasse first pointed out the similarities between otosclerosis and osteitis fibrosa of von Recklinghausen. M. Weber and Nager have also grouped otosclerosis with the reforming diseases of bone, the essential difference being that the otosclerotic process is generally slower, so that osteoclasts are rarely seen.

Wittmaack, unlike the authors mentioned, sought a local rather than a constitutional cause for otosclerosis. By producing (1919) a

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<sup>7</sup> Altmann, F. Zur Frage der experimentellen Otoklerose. Nach Untersuchungen an der knöchernen Labyrinthkapsel des Huhnes, *Monatschr. f. Ohrenh.* 71: 257 (March), 451 (April), 540 (May) 1937.

venous stasis in the region of the labyrinthine capsule in the fowl and reversing the flow of blood he succeeded in obtaining the same changes in bone that occur in otosclerosis. O. Mayer denied that Wittmaack's findings were experimental and believed that they were due to different ages of the fowls. Kamio (1924) repeated Wittmaack's experiments but obtained no otosclerotic changes. Since then the controversy between Wittmaack and O. Mayer has raged, the views of neither author having received general recognition.

In an attempt to clarify the problem Altmann proceeds first to study the normal labyrinthine capsule of the fowl in 23 specimens ranging in age from birth to 4 years. He concludes that in the new-born chick a large part of the labyrinthine capsule is already ossified and ossification is complete at about 5 months. As in the human being the labyrinthine capsule of the fowl has three layers but unlike the human enchondral layer that of the fowl regenerates bone. Because extensive pneumatization occurs from without and this rebuilding from within the resulting structure of the labyrinthine capsule is complicated.

To determine the susceptibility of the labyrinthine capsule of the fowl to experimental changes, the author studied 11 more chickens in which osteodystrophia fibrosa had been produced experimentally by the injection of bone marrow pulp. Whereas the rest of the skeleton showed a marked picture of osteitis fibrosa the changes in the labyrinthine capsule while similar were considerably less intense.

Finally, the author examined some of Wittmaack's sections of the petrous bone and concludes that the changes observed by Wittmaack are comparable to the changes observed in human otosclerosis and that they are possibly the result of venous stasis. However, the differences in structure between the human labyrinthine capsule and that of the fowl are so profound that one cannot assume without other evidence that venous stasis plays a role in the production of human otosclerosis.

Oesterle<sup>8</sup> concerns himself also with Wittmaack's experiments on chickens. He first studied 50 temporal bones from normal fowls and concludes that in the human being a solid block of cartilage is replaced by solid bone whereas in the fowl the cartilage is first extensively pneumatized. In the enchondral layer of the fowl bone is actively rebuilt with a confusion of vessels while the periosteal layer is composed of parallel lamellas of bone. In the human being by comparison the enchondral layer is homogeneous and compact and the periosteal layer is a complicated structure. Of more importance as regards experi-

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<sup>8</sup> Oesterle, F. Die normale Histologie und Biologie der Hühnerlabyrinthkapsel im Hinblick auf die experimentelle Hühnerotosklerose. Arch. f. Ohren-, Nasen- u. Kehlkopfheilk. 143:362, 1937.

mental otosclerosis than the structure is the biologic nature of the labyrinthine capsule of the fowl Wittmaack denied that bone is rebuilt after 6 months of age, but the author observes an increase in thickness of the capsule with age due to apposition of bone, while the cartilaginous rests, unlike those in man, decrease in number with age through formation of new bone In the human capsule, there is no resorption and apposition, so that fractures show little or no tendency to heal and that only from the periosteal layer The fowl's capsule, however, shows a marked ability to regenerate fairly rapidly by formation of new bone

In considering experimental otosclerosis in the fowl, one must remember that the normal labyrinthine capsule shows the characteristics of otosclerotic bone, namely, marked filling of the vessels, blue staining of the bone around the vessels and sievelike perforations of this blue-stained bone Wittmaack later admitted that in 10 per cent of normal fowls spontaneous otosclerosis develops because the pecking and scratching they receive from other fowls results in venous stasis This, of course, detracts from the validity of any conclusions based on an experimentally induced lesion

The author then operated on 2 chickens with a third as a control, injecting ferric chloride into the torcular Herophili, and killed one in three weeks and the other in five In each case thrombosis of the torcular resulted in marked venous dilatation within the skull Around the thrombus some new bone was formed and where this was close to the labyrinthine capsule the latter showed slightly increased rebuilding of bone However, these changes were slight and the normal appearance changed only slightly

The author concludes that the labyrinthine capsule of the fowl differs from that of the human being morphologically and biologically and that the normal capsule shows the criteria for otosclerosis, while producing venous stasis results in no changes in the bone which can be compared to human otosclerosis

*Treatment*—A valuable discussion on intratympanic medication with thyroxin occurred at the combined meeting of the Section of Laryngology and the Section of Otology of the Royal Society of Medicine<sup>9</sup> last year There were eleven reports of results A few investigators had obtained improvement in hearing in a small proportion of cases, one reported marked improvement in 11 out of 13 cases, and five considered the results essentially negative

Two reports are especially noteworthy Gavin Livingstone, who has continued the treatment begun by Gray in a series of cases and who

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<sup>9</sup> Discussion on Intratympanic Medication, with Special Reference to Thyroxine, J Laryng & Otol 52 115 (Feb) 1937

therefore should have good results to report if this treatment, which Gray first suggested has any value, reported on 25 cases in which a total of three hundred and sixty injections were given. No case of infection of the middle ear occurred. In 1 patient violent vertigo developed on injection into one ear and facial paralysis on injection into the opposite; the condition is improving. There were no other complications. Five patients showed improvement measured by the audiometer. Nine ears (in 5 patients) were improved while 4 ears were worse after the treatment. Subjective improvement in hearing occurred in 8 cases. Tinnitus was improved in 6 of 16 cases.

A series of injections of thyroxin and riboflavin (as a control) into the middle ears of cats failed to show that thyroxin has a specific action causing congestion of the mucous membrane. The author concludes that he is doubtful whether the optimism expressed by Dr. Gray will be fully justified but that further investigation should be carried out.

The other especially important report was by S. C. Suggitt who treated 30 patients with no improvement in 18 and some objective improvement in 12 any improvement, no matter how slight, being included. In the follow-up however, no sustained improvement in hearing, subjective or objective, has been obtained and in no case has the patient received practical material benefit. In 6 of 22 cases of tinnitus there was complete or partial relief, permanent so far. In a control series of 11 cases in which injections of physiologic solution of sodium chloride were used, improvement in hearing could be demonstrated in 7 and in 3 of 6 cases of tinnitus there was improvement. In conclusion the author states that slight practical results have been obtained by the intratympanic injection of thyroxin and that what results have been obtained were obtained equally well if not better by substituting physiologic solution of sodium chloride, which indicates that these results are due entirely to the mechanical effect of fluid in the cavity of the middle ear.

Slightly more encouraging are some of the reports on the surgical treatment of otosclerosis.

Rollin<sup>10</sup> reports the results of operating on otosclerotic patients to arrest the progress of the deafness according to Wittmack's theory, which was discussed in the section entitled "Pathology and Etiology," that otosclerosis is the result of localized venous stasis. This operation, devised by Wittmack and Methé and called elevation of the dura over the tegmen tympani, is to prevent retrograde venous flow from the plexus around the carotid or the middle meningeal artery into the bone

10. Rollin, H. Fünf-jährige Erfahrungen mit der Wittmackschen Otoskleroseoperation. *Ztschr. f. Hals-, Nasen- u. Ohrenh.* 42:304 1937.



of the labyrinthine capsule by division of the veins running through the tegmen tympani with the greater superficial petrosal nerve

The indications for the operation are strict. The diagnosis of otosclerosis must be clearly established from the history, including the absence of earlier suppuration of the middle ear, from the presence of a transparent drum membrane and a patent tube, from hearing tests indicating deafness of the middle ear and from a roentgenogram showing wide pneumatization of the mastoid process. The patient must also recently have become deaf, since the operation hopes only to stop the progress, those whose condition is advanced or stationary are excluded. The operation of Wittmaack is applicable, therefore, only in early, beginning conditions, while the operations of Bárány, Holmgren and Sourdille are for advanced conditions.

Operation has been performed in 60 cases in the past five and a half years. The results in the 45 of these cases in which one year or more has elapsed since operation are as follows. Of the 45, in only 1 did the hearing diminish in the ear operated on, while in 11 the hearing in the opposite ear diminished. There have been no complications threatening to life and no untoward after-effects. The operation is done rapidly and easily by one familiar with the technic. In a small percentage of cases hematoma forms the first day after operation, but it is always absorbed without reaction. In 2 cases in which marked postoperative hematoma occurred, facial paralysis appeared two or three days postoperatively, clearing up in fourteen days and in three months. One patient showed symptoms of labyrinthine irritation, which cleared up without influencing the hearing.

Fowler<sup>11</sup> reviews the rationale of the treatment of otosclerosis. He calls attention to the fact that, while 1 of 20 autopsies on adults shows the presence of otosclerosis, in less than a fourth of these has the disease invaded the annular ligament of the stapes and resulted in clinical symptoms. Up to the present chemical abnormalities of blood have not been found in otosclerosis, so that there is no medical means of combating the condition. Surgically it has not been possible to mobilize an ankylosed stapes.

The author calls attention to the slight variations in hearing with weather, mental states and other factors in otosclerotic patients as in all human beings. These normal variations have been responsible for many treatments for otosclerosis having been given credit for beneficial results. The fact remains that none of them has diminished the otosclerosis or the deafness resulting from it.

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11 Fowler, E. P., Jr. The Factual Background for the Treatment of Progressive Deafness from Otosclerosis, *Laryngoscope* 47:847 (Dec.) 1937.

Recently surgical procedures have been developed which have proved successful in certain selected cases of otosclerosis. These operations aim to create a new mobile window into the labyrinth to take the place of the occluded oval window so that the normal condition is reestablished, with two movable parts, one to receive sound vibrations and one for the release of sound pressure vibrations.

The author finally calls attention to the fact that one of the chief obstacles to the acceptance of the operative procedures has been the use of hearing tests of doubtful accuracy or completeness, there being doubt as to just how much change is due to the mechanical effects of the operation and how much to the psychologic.

Sourdille<sup>12</sup> reviews the principles underlying his operation for otosclerosis. First, when a permanent window, covered by thin cicatricial membrane, is opened into the perilymphatic space without injuring the membranous labyrinth, the progression of the deafness is completely arrested and the tinnitus diminished or entirely relieved. Second, an opening, no matter how small, suffices, but as soon as it is closed by an osseous callus the progressive loss of hearing resumes. The longest period over which he has observed a case is now seven years.

When the fistula is relatively extensive, 1 mm wide and 3 to 4 mm long, and so placed that it receives air-borne sounds directly, one obtains, in addition to an arrest in the progression of the deafness, a definite but slight improvement over the preoperative hearing.

To obtain a really striking improvement it is necessary to carry out a series of transformations of the drum membrane and ossicles consisting of resection of the head of the malleus and the establishment of a cicatricial plastic flap, called the "internal plastic" which extends from the superior margin of the drum membrane to the labyrinthine fistula and carries sound vibrations across the mobile incus from the pars tensa to the fistula. This operative procedure the author calls the "tympano-labyrinthopexy."

Three operative procedures, separated from each other by several months, are necessary to accomplish this result. The first is the resection of the thick skin from the superior half of the external auditory canal followed by the formation of a thin, flexible and resistant scar. The second is a complete exenteration of the mastoid cells, with resection of the head of the malleus but preservation of the incus in its normal position the middle ear cavity being excluded from the operative field by the "internal plastic." The third is the establishment of the laby-

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12 Sourdille, M. Sur le traitement chirurgical de l'otospongiose, *Ztschr f Hals-, Nasen- u Ohrenh* 40:514, 1937, New Technique in the Surgical Treatment of Severe and Progressive Deafness from Otosclerosis, *Laryngoscope* 47:853 (Dec) 1937.

rinthine fistula and the application to it of the cicatricial membrane [This procedure is somewhat modified from that described by the author a year ago and abstracted in this review]

The author has now operated on 140 patients and with this latest technic he obtains positive results for 80 per cent

Holmgren<sup>13</sup> contributes a paper to the American literature, but since it is only a repetition of the paper published in the *Acta otolaryngologica* the year before and abstracted in this summary last year<sup>14</sup> no further mention will be made of it

Howarth<sup>15</sup> having personally studied under Holmgren, operated on 7 patients with otosclerosis according to Holmgren's method but met with failure in every case, since the considerable initial improvement in hearing gradually disappeared. He then operated in 1 case, using a modification of his own, as follows. He first did a radical operation but without removing the pars tensa of the drum membrane or the ossicles and then lined the cavity with a Thiersch graft. Six weeks later he elevated the epidermis over the horizontal semicircular canal and removed the bony covering, creating the customary fistula. This method is similar to that of Sourdille except that the operation consists of only two stages. The author states that his operation has been done so recently that the duration of the immediately good result cannot yet be determined.

Hughson<sup>16</sup> reports on 8 cases of "conduction deafness with normal drum membranes" in which operation was based on experiments carried out by himself and Crowe six years before, in which plugging of the niche of the round window was followed by improved electrical response from the eighth nerve of experimental animals. Patients were selected who had a loss of hearing of not more than 50 decibels for the voice frequencies. [The author states that the deafness cannot be of the nerve type, but he does not give any reason for limiting his operation to cases of conduction deafness.] The operation consisted of placing a small piece of fascia removed from behind the ear into the niche of the round window through an incision of the drum membrane after freshening the margins of the window by rubbing gently with cotton. The poorer ear was operated on in each of the 8 cases. [The author reports an improvement in hearing in each case, but careful scrutiny of

13 Holmgren, G. The Surgery of Otosclerosis, *Ann Otol, Rhin & Laryng* **46** 3 (March) 1937

14 Shambaugh, G. E., Jr. Chronic Progressive Deafness Including Otosclerosis and Diseases of the Inner Ear, *Arch Otolaryng* **26** 583 (Nov.) 1937

15 Howarth, W. The Surgical Treatment of Otosclerosis, *St. Thomas's Hosp Rep* **2** 153, 1937

16 Hughson, W. Grafts in the Round Window in the Treatment of Certain Types of Deafness *Arch Otolaryng* **25** 623 (June) 1937

the published audiograms fails to show a striking or uniform improvement, the variations being similar to the normal variations that are always observed in otosclerosis, with slight improvement at times for certain frequencies but worse hearing for other frequencies, while in some cases the ear not operated on appears to show more improvement than that operated on ]

A contribution by Milstein<sup>17</sup> has some bearing on Hughson's work. Milstein closed the round window in cats with bony fragments, fat, muscle and fascia colli and found that the fascia was best. The animals were then exposed to loud sounds, after which the ear was examined histologically. He noted that the animals operated on showed practically no degeneration of Corti's organ as compared with degeneration of all elements of Corti's organ in the control cats. He concludes that closure of the round window is a protection against the influence of loud sounds on the endings of the eighth nerve [presumably by diminishing the intensity of sound vibrations reaching the cochlea, i. e., closing the round window leads to a diminution in hearing].

Reports on the treatment of otosclerosis by medical or physical therapeutic means were somewhat fewer than usual in the literature for 1937.

Seiferth,<sup>18</sup> having noted the histologic similarity between otosclerosis and osteitis fibrosa of Recklinghausen, has carried out new studies on the mineral metabolism in otosclerosis with the following results. Of 15 otosclerotic patients, 6 showed hypercalcemia and 6 more a slight elevation in the calcium content of the blood (11 and 12 mg per hundred cubic centimeters), while in 2 the calcium was normal and in 1 slightly lowered. For all 15 the excretion of calcium in the urine was increased. The phosphorus in the blood was diminished in 6, slightly lowered in 4 and normal in 5. These variations correspond to what is found in osteitis fibrosa of Recklinghausen.

Because of the close relation between mineral metabolism and the endocrine system, the author sought a method of measuring the condition of the endocrine glands in otosclerosis. By means of Abderhalden's reactions, with the interferometer method of Hirsch, it is possible to measure this quantitatively. In all cases the parathyroids showed an increased reaction (indicating involution). In all but 1 of the female patients the value for the testes was increased and that for the ovaries normal. In 2 men a so-called paradoxical value for the testes was obtained. The author concludes that otosclerosis is definitely endocrine.

17 Milstein, T. N. Zur Technik des Verschlusses des runden Fensters im Zusammenhang mit den zugehörigen Fragen der Ohrphysiologie, und Pathologie, Arch. soviet otol., 1937, no. 3, p. 11.

18 Seiferth, L. B. Zur Ätiologie und Behandlung der Otoklerose, Ztschr. f. Hals-, Nasen- u. Ohrenh. 42: 298, 1937.

in origin, the disturbance lying in the parathyroids and testes, especially in the parathyroids

In attempting therapy solution of parathyroid was found impractical because of the expense and the need of hospitalization. A 0.5 per cent solution of dihydrotachysterol, a conversion product of ergosterol, while it has no chemical relationship to the parathyroid extract, can completely replace the latter and has been used for tetany due to underfunction of the parathyroids with excellent results.

Up to now 12 otosclerotic patients have been treated with this solution of dihydrotachysterol. Five have shown a definite improvement in one or both ears (as shown by audiometer curves). The dose is 20 drops daily, gradually increasing to 25 to 30 drops a day, with repeated determinations of calcium and phosphorus. Overdosage is to be avoided.

In the discussion that followed this paper, Leiches stated that in several hundred studies of the blood in cases of otosclerosis he had never found increased calcium values and the phosphorus was always normal.

Selfridge<sup>19</sup> obtained detailed dietary histories and detailed chemical determinations on the blood of 5 patients with clinical otosclerosis. Each patient had or had had at some previous time a diet deficient in one or more vitamins, and each patient showed a slight deficiency in one or more of the chemical determinations on the blood. [None of the patients gave clinical evidence of a deficiency in vitamins nor did the author compare his otosclerotic patients with controls with normal hearing. One suspects that most persons would show equal deficiencies in vitamins in their dietary histories and equal abnormalities in the composition of the chemical blood.] The author then administered vitamin concentrates (A, B, C and D) to the 5 otosclerotic patients and obtained slight improvements in hearing. [These improvements, again, were not sufficient to be convincing.]

Sann<sup>20</sup> administered small doses of roentgen rays over the stellate ganglion in patients with tinnitus and deafness who showed disturbances of the sympathetic nervous system. Considerable improvement in hearing resulted at times. Irradiation of the hypophysis had no influence on the hearing.

Landry<sup>21</sup> applied ionization (previously used in the treatment of suppurative otitis media) in cases of deafness in which the drum

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19 Selfridge, G. Chronic Progressive Deafness from a Nutritional Standpoint, *Ann Otol, Rhin & Laryng* **46** 875 (Sept.) 1937.

20 Sann, R. Der Einfluss von Röntgenbestrahlungen des Ganglion-stellatum auf Hörstörungen, *Hals-, Nasen- u. Ohrenarzt* (Teil 1) **28** 241 (July) 1937.

21 Landry, M. Behandlung der chronischen, nichteitrigen Ohrenentzündungen mittels der Dielektrolyse in Verbindung mit der Hochfrequenz, *Ztschr. f. Hals-, Nasen- u. Ohrenh.* **40** 673, 1937.

membrane was intact. The author asserts that experiments have shown that the ionization penetrates not only into the middle ear but into the inner ear from the external auditory canal. A solution of iodine ions is used for adhesive otitis, of calcium ions for otosclerosis and of silicon ions for dry otitis. The coincident use of high frequency diathermy is of value and also is of psychologic benefit. The results in cases of chronic adhesive otitis are better than 6 of 10 patients benefited. In cases of chronic catarrhal otitis the results are even better. In most cases of otosclerosis the tinnitus is diminished, the hearing is improved in one third of the cases in which the condition of the labyrinth is good. [While difficult to disprove without repeating the work this and the previous articles on the medical treatment of otosclerosis are even more difficult to believe.]

Friesner and Druss<sup>22</sup> on the basis of histologic study of suppurative otitis media in the acute and the healed stage suggest that similar changes in the middle ear may be the result of repeated catheterization and inflation, particles of mucus being injected into the middle ear. They further suggest that the progressive loss of hearing that is observed in spite of repeated and prolonged treatment of the eustachian tube may be the result of the treatment, with repeated insults to the mucosa of the middle ear. In the discussion that followed, Page disagreed with the statement of the harmful effects of inflation with the catheter, having found this treatment of the greatest benefit in the treatment of subacute catarrhal conditions of the middle ear. [It appears that Friesner and Druss fail to differentiate clearly between otosclerosis with alterations of the drum membrane and progressive deafness chronic adhesive deafness with changes in the drum membrane but without progressive deafness and acute secretory catarrh. For the latter, inflation of the eustachian tube by the catheter is the treatment of choice. In chronic adhesive deafness without otosclerosis there is no progress in the defect in conduction in the absence of recurring acute attacks of otitis media, while in otosclerosis with changes in the drum membrane the progressive deafness has nothing to do with the eustachian tube and the cavity of the middle ear.]

#### LABYRINTHINE DEAFNESS

*Pathology of Nerve Deafness*—H. von Fieandt and Saxén<sup>23</sup> contribute a monumental work on the pathology of senile nerve deafness

<sup>22</sup> Friesner, I. and Druss, J. G. Critique of the Present Treatment of Deafness Due to Lesions in the Conduction Mechanism, *Arch. Otolaryng.* **26** 259 (Sept.) 1937.

<sup>23</sup> Saxén, A. Pathologie und Klinik der Altersschwerhörigkeit nach Untersuchungen von H. von Fieandt (†) und Arno Saxén. Vorläufige Mitteilung, *Acta oto-laryng.* 1937 supp. 23 p. 1.

with a correlation between the clinical findings and the histologic picture. The authors point out that while the clinical characteristics of senile deafness have been known for a long time, the pathologic basis for the loss of hearing has been poorly understood. Zwaardemaker first called attention to the lowering of the upper tone limit and the diminished hearing for high tones which begin at a comparatively early age and become more pronounced with advancing years.

In reviewing previous histologic work on senile deafness, the authors note that Sporleder, finding no definite pathologic changes in the labyrinths of 5 elderly patients examined during life, concluded that the lesion in senile deafness lies centrally rather than peripherally. All other authors, however, have placed the lesion in the inner ear or the auditory nerve. Generally all degenerative conditions of the inner ear have been grouped together as chronic progressive labyrinthine deafness, with pathologic changes in four places: the ductus cochlearis, the spiral ganglion, the finer nerve fibers of the cochlea and the trunk of the eighth nerve. Wittmaack has attempted to differentiate histologically various types of chronic progressive labyrinthine deafness as follows:

Genuine neuroepithelial degeneration, a true primary degenerative process, which involves not only the cochlear duct and Corti's organ but also to a similar extent the vestibular portion, the maculas and cristae acusticae.

Atrophic degenerative changes of the nerve trunk.

Peripheral cochlear degeneration, in which a degenerative atrophy of the so-called peripheral cochlear neurons occurs and all the elements which form this peripheral neuron are generally destroyed, the ganglion cells of the spiral ganglion, the nerve fibers in the osseous lamina spiralis and the hair cells of Corti's organ.

This classification of Wittmaack is the one generally accepted in considering the histology of nerve deafness. In considering which type of pathologic change occurs in senile deafness there is, however, a wide diversity of opinion. The authors set out to clarify this question.

The material for this study was found in a home for the aged, the inmates showing deafness being subjected during life to an otologic examination including otoscopic inspection, hearing tests (whisper and tuning forks) and caloric and rotation tests. Material for histologic study was obtained from 44 of those examined, at an interval of a few days to several months, rarely more than a year, after the last hearing test. The distribution by age was as follows: 50 to 60, 1 patient; 60 to 70, 3 patients; 70 to 80, 10 patients; 80 to 90, 16 patients; over 90, 3 patients. The temporal bones were fixed three to twenty hours post mortem. Of the 44 cases studied, aural changes that could not be

ascribed to age were found in 11 33 remaining in which the deafness could be termed senile

The 33 cases of senile deafness were grouped according to the histologic pictures as follows senile atrophy of the cochlear ganglion 13 cases angiosclerotic degeneration of the inner ear, 19 cases central deafness, 1 case

The histologic observations in these three groups are described in detail.

Senile atrophy of the spiral ganglion includes the spiral ganglion cells and the nerve fibrils and affects the proximal part of the cochlea (basal coil) The organ of Corti is spared and arteriosclerosis of the blood vessels is not seen Any changes that occur in the trunk of the cochlear nerve appear to be secondary to that atrophy of the spiral ganglion rather than primary in the nerve This confirms the work of Crowe Guild and Polvogt

Angiosclerotic degeneration of the inner ear results from sclerosis of the local blood vessels, with disturbed nutrition of the epithelial part of the ductus cochlearis, which shows changes When the secretory epithelium of the stria vascularis is involved, there is in addition to the degeneration of the organ of Corti collapse of the cochlear duct Angiosclerotic degeneration in the labyrinth is not always accompanied by sclerosis of the vessels of the base of the brain or general cerebral arteriosclerosis It is frequently associated with a genuinely arteriosclerotic contracted kidney

The two lesions, senile atrophy of the spiral ganglion and angiosclerotic degeneration of the inner ear occur together but also separately since atrophy of the spiral ganglion does not occur in every case of angiosclerotic degeneration of the hair cells and often occurs alone with a normal organ of Corti

The case of central deafness was that of a woman aged 77 with arteriosclerotic dementia The right ear was entirely deaf while the left showed some remnants of hearing Histologically the peripheral hearing apparatus showed a normal organ of Corti with few changes in the auditory nerve, the ganglion cells of the spiral ganglion being reduced only in the basal coil Because of the lack of peripheral pathologic change in spite of profound deafness a central origin was diagnosed although the exact location could not be determined There was an unusually diffuse sclerosis of the arteries of the whole body with thrombosis of the right iliac artery and gangrene of the fingers of the right hand

In correlating the clinical with the histologic observations, the authors found that the defect in hearing corresponded to the atrophy of the spiral ganglion cells, so that angiosclerotic degeneration when it occurred alone was often accompanied by no noticeable disturbance in hearing



The hearing may be not only good but entirely normal to all tests, even when Corti's organ is markedly atrophied and the hair cells entirely absent

The static labyrinth reacted normally in all cases and showed slight changes histologically

The authors regard senile atrophy of the spiral ganglion as a condition resulting from wear—a process of exhaustion or using-up peculiar to old age. Central lesions are rarely the cause of senile deafness and are to be suspected when there is loss of hearing for the low tones as well as for the high

The authors suggest that the shortened bone conduction in old age may be due to angiosclerotic changes, with diminished production of endolymph and collapse of the cochlear duct

Two articles on the interpretation of histologic observations on the cochlea have a bearing on the changes described by von Fieandt and Saxén

Werner,<sup>24</sup> discussing the artefacts that occur in preparing sections of the inner ear, comes to the following conclusions

- 1 For the interpretation of sections it is extremely necessary not only to recognize artificial and autolytic changes but to understand their causes

- 2 In the fixing solution substances are dissolved from the tissue partly by changes in hydrogen ion concentration and partly as the result of alcohol. During decalcification they may be further dissolved

- 3 By postmortem autolysis substances come from the tissues into the labyrinthine spaces, where they appear as precipitates. Agonal origin of such precipitates is to be rejected

- 4 Precipitates of every sort in the labyrinthine spaces can cause additional changes, solution and diffusion into other spaces, deposits on the walls, sedimentation, thickening and shrinking. Thus membranes can become weighted down and held in normal or pathologic positions

- 5 Roof and walls of the ampulla are osmotically crushed by the pyroxylin or by rinsing through fixation, in that the acidity determines the loosening of the endosteum or laceration of the perilymphatic fibers

- 6 The weighting down of Reissner's membrane is determined not only by the amount of fluid during life in the ductus cochlearis and scala vestibuli but also by the changes in the fixation and decalcification solutions and in the alcohol and pyroxylin. In this way the position of the membrane can change

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<sup>24</sup> Werner, F. Ueber artifizielle Veränderungen des Innenohres und Ihre Beziehungen zu den pathologischen Vorgängen, *Monatschrift für Ohrenh.* **71** 1017 (Sept.) 1937

7 The condition of Reissner's membrane is no reliable indicator of the hydrostatic pressure of the endolymph in the ductus cochlearis. By a slight ectasia the increased surface is so small that it has no noteworthy resistance to pressure.

8 The volume of the cupola is influenced by the hydrogen ions and the concentration of the fixation solution, by the duration of fixation, decalcification and dehydration and even by the changes in colloidal state of its substance, but not by osmotic pressure.

9 Shrinkage of the cupola is prevented by embedding in pyroxylin, in gelatin or in artificial exudate or by embedding in exudate during life or in necrotic masses.

10 The variable pictures of the tectorial membrane are explained by shrinkage in its three dimensions, shrinkage, shortening and elevation (as a spiral shortening). Marked shrinkage of the membrane held fast to Corti's organ is mechanically explained without assuming a lessening of its fluid content during life.

11 The different conditions of the otoliths depend above all on the condition of their organic coverings which remain after dissolution of the crystals.

12 The artificial (and autolytic) changes are not separated sharply in position or characteristics from pathologic (intravital) changes and are intermingled on the same portion of tissue in different ways.

Lange<sup>25</sup> points out that difficulty in differentiating antemortem from postmortem changes has made it difficult to correlate the histologic picture with the defects in hearing. In order to determine which changes occurred post mortem the author studied the cochleae of 10 patients whose hearing when tested within twelve hours before death was normal. In 4 cases he found changes which are generally accepted as of post-mortem origin: loosening of the epithelial cells of the organ of Corti, with escape of protoplasm from these cells but with a thin, tightly stretched Reissner's membrane and a thick tectorial membrane.

In 5 cases he found changes previously described as "genuine neuro-epithelial degeneration," with a flattening of the epithelial cells, the tectorial membrane usually lying flattened on them and Reissner's membrane often collapsed and lying on them so that a flattened, almost homogeneous mass is all that remains of Corti's organ. The author discards the assumption that these changes were present before death, with normal hearing, since this would mean that Corti's organ is not necessary for hearing. Since in 1 patient the cochlea was opened before fixation on one side and left unopened on the other and the opened

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<sup>25</sup> Lange, W. Horleistung und pathologisch-anatomischen Befund im Ductus cochlearis, *Ztschr. f. Hals-, Nasen- u. Ohrenh.* **41** 209, 1937.

side showed only postmortem changes while the unopened side showed "genuine neuroepithelial degeneration," the author suggests that the latter is due to delayed fixation, with postmortem changes

In conclusion the author points out that there is no clearcut dividing line between intravital changes, postmortem changes and artefacts, so that for the present there is no consistent histologic picture of the organ of Corti in persons with normal hearing shortly before death

Lurie<sup>26</sup> studied the histologic picture of the ears of animals experimentally deaf from an operation on the cochlea, from long exposure to intense tones or from chemical poisons or congenitally deaf, obtaining an electrical audiogram before death. The only histologic change that corresponded to loss of hearing was degeneration of the hair cells, with loss of nuclei of these cells. Abnormalities of other structures in the cochlea had no apparent relation to defects in hearing. The external hair cells were the first to degenerate. With these gone and the internal hair cells intact, there was partial loss of hearing. With both external and internal hair cells absent there was complete loss of hearing. The audiogram could, in fact, be accurately predicted from the histologic study of the distribution of hair cells (i.e., if the cells were deficient in the basilar turn and present in the apical turns, the audiogram would show a loss of hearing for high tone)

[The observations of Lurie agree with the statement of Lange that normal hearing with loss of hair cells means postmortem changes, not that the organ of Corti is unnecessary for hearing. In the cases of angiosclerotic degeneration of the inner ear with normal hearing described by von Fieandt and Saxen the condition must therefore be regarded as possibly due to postmortem changes.]

Lewy<sup>27</sup> contributes an article on the pathology of nerve deafness. Injuries at birth, with hemorrhages into and around the eighth nerve at the porus acusticus and where the blood vessels enter the modiolus, may result in partial degeneration of the spiral ganglion and deafness.

The progressive deafness of tabes is usually due to gummatous infiltration of the meninges around the eighth nerve, gradually strangling it. Every syphilitic patient with progressive nerve deafness, whether or not diagnosed as tabetic, should have a spinal puncture, and whenever increased cells or protein are found, indicating an active process, immediate treatment is indicated.

The author believes that not only meningococcic meningitis but also measles, scarlet fever, typhoid and influenza may cause deafness by

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26 Lurie, M. H. Pathology of the Organ of Corti, *Laryngoscope* **47** 418 (June) 1937

27 Lewy, F. H. The Pathology of Nerve Deafness, *Laryngoscope* **47** 409 (June) 1937

an inflammatory meningeal exudate in the cerebellopontile angle, with destruction of the acoustic nerve, the ventral nucleus and the tuberculum acusticum and with comparative preservation of the vestibular nerve. He suggests that a spinal tap be performed at the first decrease in hearing through infectious diseases, for diagnosis and to drain infectious material out of the cerebellopontile angle.

Nerve deafness from tumors of the cerebellopontile angle is then reviewed. These tumors fall into the following classes:

- 1 Tumors of the cerebellum give cerebellar and later medullary and cranial nerve signs from pressure, but the hearing remains normal for a long time, any deafness being due to pressure on the eighth nerve.

- 2 Tumors of the pons present early paralysis of the extremities and ocular muscles, conjugate deviation of the eyes, sensory disturbances and caloric inexcitability but almost no pressure or auditory symptoms. Little or no deafness but ipsilateral vestibular failure strongly suggests an intramedullary lesion.

- 3 Glaucomatous involvement of the lateral cistern, usually part of generalized cisternal arachnoiditis, does not involve hearing. If there is loss of hearing in such a case, a tumor behind the arachnoiditis should be suspected.

- 4 Meningiomas of the posterior fossa occur particularly at the transverse sinus, with no auditory symptoms, at the foramen jugulare, with auditory symptoms entirely in the background, and in the porus acusticus internus, where early subjective and objective symptoms of involvement of the eighth nerve are produced.

- 5 Tumors of the eighth nerve itself are divided into

- (a) Medial acoustic tumors, the least frequent variety, and the only one permitting complete surgical removal, are those originating from the free intracranial portion of the nerve. Subjective and objective cochlear symptoms are late as compared with increased intracranial pressure and vestibular signs. Cushing emphasizes that these tumors produce first intracranial and then auditory symptoms. When the hearing varies considerably over a short time, the deafness may be due to hydrops of the eighth nerve analogous to a choking of the optic nerve. [This analogy was suggested in an article by H. Brunner abstracted in last year's summary<sup>14</sup>]

- (b) Lateral acoustic tumors are those occurring in the distal portion of the nerve within the internal auditory meatus. Deafness is usually complete many years before intracranial symptoms appear. The internal auditory meatus becomes considerably enlarged, and later the tip of the pyramid is destroyed. These tumors cannot be radically removed,

but repeated reduction by partial removal assures a fairly comfortable life. The facial nerve may be involved but is rarely completely paralyzed.

(c) Neurofibromas of the von Recklinghausen type are usually multiple and bilateral, with bilateral deafness and loss of vestibular function.

As compared with these extramedullary causes of eighth nerve deafness little is known of nerve deafness from a lesion of the brain stem or the cortex, except that it is apparently unusual.

Wittmaack<sup>28</sup> makes a prediction that in future studies on the pathogenesis of nerve deafness more attention will be paid to the secretion of endolymph and perilymph and the relation of their pressure. Up to now consideration of diseases of the inner ear has practically overlooked the fact that all parts of the inner ear are so surrounded by endolymph and perilymph that the pathology of the inner ear must basically take them into consideration. These fluids have a true circulation, the perilymph being a diffusion from the network of blood vessels, while the endolymph is secreted by highly differentiated epithelial cells. In the ductus cochlearis the main source of endolymph secretion is the epithelium of the stria vascularis, but part of Corti's organ itself also is a source of endolymph. The author believes that as the result of secretion in Corti's organ itself this organ first unfolds, and therefore this endolymph has a somewhat higher pressure than the rest of the endolymph. The exit for the endolymph in Corti's tunnel is probably the small spaces around the nonmedullated nerve fibers. In the sacculus and utricle the sensory cells themselves secrete, as does the higher epithelium of the adjacent walls. The exit for the endolymph is the saccus endolymphaticus, to whose epithelium the author ascribes the power of resorption. In the perilymphatic space the flow is from the network of vessels in the walls, from which the perilymph comes as a dialysate, out through the aquaeductus cochleae, but there is also resorption from the venous network of the lining walls. The nerve endings of the cochlea with their blood vessels project into these lymph spaces. The tonus of the nerve endings decides their irritability and is influenced by the relation of the pressure of the labyrinthine fluids. These relations of pressure are centrally regulated.

*Hereditary Nerve Deafness*—The German law for the prevention of the propagation of hereditary disease is responsible for the continued interest in hereditary deafness in the German literature.

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28 Wittmaack, K. Betrachtungen über die Erkrankungsprozesse des inneren Ohres auf der Grundlage der Tonuslehre, Arch f. Ohren-, Nasen- u. Kehlkopfh. 141 25, 1936.

Lange<sup>29</sup> studied the condition of the teeth in children in the Leipzig Institute for the Deaf and Dumb in an attempt to show that anomalies in the teeth might assist in differentiating hereditary from acquired deafness. Anomalies in the teeth were present in 38 per cent of the children with a history of hereditary deafness and in only 12 per cent of those with a history of acquired deafness. However, the number of cases was too small to have any significant statistical value. The author then demonstrated that dental caries was more frequent in the deafened children than in a control group of children with normal hearing. He suggests that the children with acquired deafness had an inherited weakness of the auditory mechanism associated with an inherited weakness of the teeth. [It seems more logical to ascribe the greater frequency of dental caries among the children in the institution for the deaf and dumb to poor diet.]

Muck<sup>30</sup> repeated the experiments of Huber and Korosi who found the epinephrine probe test of value in differentiating acquired from hereditary deafness. The test was done on 46 children from the Deaf-Mute Institute of Essen. The test was negative for only 7 of the 46 and since all 7 gave a family history of deaf-mutism and there was no doubt that their deafness was hereditary the author concludes that a negative reaction to the epinephrine probe test is definite evidence of hereditary deafness. A positive reaction, on the other hand, is not sufficient evidence of acquired deafness since positive reactions were met in cases both of acquired and of hereditary deafness. (If a white line appears on the inferior turbinate after it is stroked with a cotton-tipped probe dipped in epinephrine the reaction is considered positive.) Since he previously demonstrated that any injury of the pial vessels (meningitis, meningismus, trauma) will result in a permanently positive reaction to the test, the author suggests that in acquired deafness there is a disturbance of the pial vessels.

Müller<sup>31</sup> tested Langenbeck's rule that bilaterally symmetric defects in hearing, with an intact vestibular apparatus are evidence of hereditary deafness. Of 15 cases of hereditary deafness bilaterally symmetric remnants of hearing were present in only 33⅓ per cent with vestibular abnormalities in 40 per cent. Of 19 cases of acquired deafness vestibular abnormalities were present in 73 per cent and remnants of hearing in only 1 case and in that they were asymmetric. The author concludes

29 Lange, J. H. Zahnuntersuchungen bei Taubstummen, *Ztschr. f. Hals-Nasen- u. Ohrenh.* **43** 38 1937.

30 Muck, O. Die Beurteilung der Taubstummheit nach dem Gesetz zur Verhütung des erbkranken Nachwuchses unter der Lupe des Adrenalin-Sondenversuches, *Ztschr. f. Hals- Nasen- u. Ohrenh.* **41** 408 1937.

31 Müller, E. Der Organbefund bei der erbten Taubheit *Arch. f. Ohren-, Nasen- u. Kehlkopfh.* **142** 376 (Oct.) 1937.

that while Langenbeck's rule holds true part of the time it cannot be relied on for purposes of sterilization because there are too many exceptions. The family history is still the essential factor.

Scheidele<sup>32</sup> also tested Langenbeck's rule on a large number of deaf-mute children and found bilaterally symmetric remnants of hearing in 100 per cent of cases of true hereditary deafness with intact vestibular function, while in cases of acquired deafness this combination was never seen. However, while he admits that symmetric remnants of hearing with normal vestibular reactions are evidence of probably hereditary deafness, he states that for final proof a family history of deafness is required.

Langenbeck<sup>33</sup> believes that without a family history hereditary deafness can be affirmed when bilaterally symmetric remnants of hearing are found, since they are found in 4 of 5 cases of hereditary deafness, but are never found in acquired deafness. Since such remnants of hearing can be demonstrated only with large sets of tuning forks or audiometers, the study of all cases in which the hereditary nature of the condition is questionable should be done in the larger otologic clinics.

Schwarz<sup>34</sup> reviews in detail the diagnosis of hereditary deafness. Two forms of hereditary deafness must be differentiated: 1. The recessive or sporadic type. 2. The dominant type (also called the hereditary-degenerative type). In cases of the dominant type other members of the direct family must be investigated, and since this deafness is a dominant characteristic it is usually not difficult to find other deaf persons. However, the mere fact that the father or mother has inner ear deafness does not prove the hereditary nature of the condition, since acquired inner ear deafness is not uncommon.

In sporadic deafness the family history is more difficult to trace, since the direct ancestors and descendants may be normal. Other cases of deafness will be found just as often in the side branches of the family tree as in the direct line of descent. Church, family and town records must all be searched, and the investigation is usually made easier because sporadic deaf-mutism is practically always complete and difficult to conceal as compared with dominantly inherited defective hearing, with which the patient has only a partial loss and often maintains steadfastly that he has normal hearing.

Parents related by blood are regarded as significant evidence in cases of sporadic deaf-mutism, but close relationship alone is not sufficient evidence of hereditary deafness.

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32 Scheidele, J. Beitrag zur Differentialdiagnose der erworbenen und erblichen Taubheit, *Arch f Ohren-, Nasen- u Kehlkopfh* **142** 336, 1937.

33 Langenbeck, B. Begutachtung erblicher Taubheit, *Erbarzt* **4** 65, 1937.

34 Schwarz, M. Familiennachweis und Organbefund bei der Begründung der erblichen Taubheit, *Erbbl f d Hals-, Nasen- u Ohrenarzt*, February 1937, no 1, p 1, in *Hals-, Nasen- u Ohrenarzt (Teil 1)*, February 1937.

A mutation cannot be diagnosed except by the descendants

The author then goes into the findings in the ear. He is of the opinion that further experience is necessary before Langenbeck's symmetric remnants of hearing can be accepted as valid for diagnosis of dominant hereditary defective hearing.

While vestibular reactions are generally assumed to be present in hereditary deafness they may be disturbed so that the findings in the ear alone are not conclusive in the diagnosis of hereditary deafness.

The development of speech is of some importance, because it never develops in sporadic deaf-mutism without special instruction but does develop normally in dominant hereditary defective hearing (unless the deafness is profound).

The author concludes that present day thought is opposed to placing the findings in the ear in too great prominence because they are not conclusive and the same findings that occur in hereditary deafness can also occur in acquired deafness. The findings in the ear are only confirmatory evidence, the family history being of primary importance. Hereditary deafness cannot be diagnosed by exclusion, that is, merely because one cannot determine the cause of inner ear deafness.

Takahashi<sup>35</sup> reports a father and 3 children (2 other children died of nasal hemorrhage) with defective hearing combined with sigmatism, the 's' sounds being replaced by "t" sounds. Hearing tests showed a labyrinthine type of deafness, the sigmatism being due apparently to loss of hearing for high tones. Repeated intermarriages between uncles and nieces in the family for four generations was responsible for this hereditary deafness, the author believes.

*Traumatic Nerve Deafness*—Bunch<sup>36</sup> reviews the English literature on occupational nerve deafness, pointing out that "blacksmith's deafness" was first mentioned in 1831 by Fosbroke. While numerous studies have been made on occupational deafness with tuning forks all authors being agreed that the defect is of the nerve type involving the high tones more than the low tones little work has been done with the audiometer. In 1928 Fowler noted the frequent occurrence of a marked dip in the audiogram between 1,000 and 5,000 cycles, most often about 3,000 or 4,000 and suggested that acoustic trauma or toxic neuritis was the cause. In 1936 Shambaugh mentioned a dip in the audiogram at 2048 and 4096 seen in cases of occupational nerve deafness.

The author extensively investigates the diagnosis of occupational deafness by the audiogram including in the study boilermakers (8 cases).

35 Takahashi, R. Labyrinthäre Schwerhörigkeit mit Sigmatismus bei einer Familie, die über mehrere Generationen blutverwandtschaftlich war, Oto-rhino-laryng 10.7 (Jan.) 1937.

36 Bunch, C. C. The Diagnosis of Occupational or Traumatic Deafness Laryngoscope 47:615 (Sept.) 1937.



patients deafened from exposure to gunfire (7 cases, large guns, 17 cases, small guns), patients deafened by loud noises in the telephone (6 cases), locomotive engineers (3 cases) and a miscellaneous group of patients with occupational or traumatic nerve deafness (10 cases)

In each group the same characteristic curve was seen the tones below 1024 were relatively near normal, while there was a sharp dip for the higher tones, most marked for 4096 The deeper the dip at this point, the broader it becomes, involving 2048 and eventually 1024 and the higher tones, above 4096

In 2 cases of deafness from caisson disease there was quite a different curve an almost uniform loss of hearing for all tones

Histologic studies have been made in cases of occupational nerve deafness by Bruhl, Habermann and Guild, and the findings are in agreement an atrophy of the organ of Corti localized to the basilar turn, with a fairly sharp transition from total loss of nervous elements to a normal nerve, the apical turns being normal

The author concludes that in traumatic or occupational nerve deafness there is a localized injury to the organ of Corti in the basilar turn leading to the following symptoms

- 1 The first evidence is an abrupt dip in the audiogram, usually near c-5 (4096) When a dip of this sort is found, acoustic trauma should be suspected and inquired into

- 2 With continued trauma this dip deepens and becomes broader, but many times there is a tendency for the hearing to approach normal for the very high tones, 8192 and above Little loss for the spoken voice will be noted unless the dip includes c-4 (2048)

- 3 Low tones (512 down) are least often involved, and when they are involved the loss is never as great as for high tones

- 4 The greatest loss consistently appears near c-5

The author points out finally that all ears are not affected equally by the same trauma Loud noises have a greater traumatic effect when in a closed chamber

Minkin<sup>37</sup> tested the hearing of 126 coppersmiths, repeating the tests seven months later He concludes that damage from noise does not occur equally rapidly in all cases, but depends on the constitutional resistance of the individual ear as well as on the type and intensity of the noise The earliest symptom is a loss for the tones c-4 and c-5, with shortened bone conduction but normal perception of a whisper When damage from noise is detected early, the hearing can be preserved by changing the occupation

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37 Minkin, E Zur Frage einer fruher Diagnostik durch Larm verursachten Storungen des Gehororgans, *Vestnik otol*, 1937, no 2, p 166

Kawata<sup>38</sup> exposed guinea pigs to a loud noise of an intensity of 105 decibels, with the maximum tone of the noise at about 2730 vibrations. He used the ear muscle reflex as an indication of loss of hearing for this tone. The loss of hearing was greatest after exposure for ninety to one hundred and one hundred and seventy to one hundred and ninety days. Histologic study of 1 guinea pig exposed for one month showed complete destruction of Corti's organ localized to the transition between the basal coil and the second turn. However, another guinea pig, whose ear muscle reflex for all tones disappeared after exposure for fifty days, had a normal organ of Corti when examined histologically but a markedly damaged, nearly absent, spiral ganglion in all turns.

Haarmann<sup>39</sup> describes 4 cases of electrical damage to the ear:

1. Tinnitus and dizziness following an electrical discharge in the receiver but with normal hearing and vestibular reactions (possible traumatic neurosis)

2. Moderate inner ear deafness after a stroke of lightning (organic damage)

3. Staggering gait after a five minute contact with a high tension wire followed by eight hours of unconsciousness

4. Fracture of the left temporal bone after a two second contact with a power circuit, resulting in a fall of 6 feet (1.8 meters) onto the head

Hallpike<sup>40</sup> describes a case of deaf-mutism of traumatic origin. A man of 59 had been deaf apparently all his life and certainly from the age of 3 years. There was no family history of deafness and no history of injury to the head. Autopsy showed an old partly healed transverse fracture through the right labyrinth, with advanced degeneration of Corti's organ of both ears and formation of new bone in the perilymphatic spaces of both ears. The author concludes that a fracture of the skull in early childhood led to destruction of the right labyrinth, with infection of this labyrinth, low grade meningitis and invasion of the opposite labyrinth through the internal auditory meatus, resulting in complete deafness.

Blegvad<sup>41</sup> defines concussion of the labyrinth as deafness resulting from a strong and sudden sound, with or without a simultaneous increase in air pressure. Fracture of the temporal bone is not included.

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38 Kawata, S. Experimentelle Studien über die Larmschädigungen des Gehörorgans, *Jap J. M. Sc.*, XII, *Oto-Rhino-Laryng* 2:77 (Sept.) 1937.

39 Haarmann, H. Zur Frage der Ohrschädigung beim elektrischen Unfall, *Hals-, Nasen- u. Ohrenarzt* (Teil I) 28:49 (Feb.) 1937.

40 Hallpike, C. S. On a Case of Deaf-Mutism of Traumatic Origin, *J. Laryng. & Otol* 52:661 (Oct.) 1937.

41 Blegvad, N. R. Modern Views on Concussion of the Labyrinth, *J. Laryng. & Otol* 52:265 (April) 1937.

Concussion of the labyrinth was seen chiefly during the war, following explosions of shells and usually associated with other bodily injuries, especially when the person was partly buried by the explosion. At first it was believed that this deafness was permanent and the defect was organic. However, the caloric reaction is always retained, and after the war few veterans obtained disablement benefits for this kind of deafness, because most of those who had had it had recovered their hearing partly or completely. It was found that recovery was most rapid in soldiers who remained at the front and was slowest in those who were sent to base hospitals or home. However, these were not cases of malingering, since deafness was accompanied by extensive sensory disturbances, especially around the ear, nor were they cases of true hysteria, since there was no previous history of hysteria. The author applies the term psychogenic deafness to this condition, since the disturbance lies in the cerebral cortex rather than in the labyrinth.

The diagnosis of psychogenic deafness is indicated by the sudden loss of hearing with retained caloric response, after a loud explosive noise, by variation in the hearing tests from day to day, by tests indicating perception deafness though the hearing for low tones may be impaired more than that for high, by hesitation of the patient before repeated words used in testing and finally by the fact that lip reading is learned rapidly but when the ear canals are plugged the patient can no longer read lips, which proves that he has been hearing.

Certain tricks help to detect psychogenic deafness. The patient is asked, in writing, to sing a song after an initial note is struck on the piano. If he begins on this note, he hears.

In treatment, suggestion may be used. Above all, it is important that the economic aspects be settled so that the patient does not profit by permanent deafness.

*Nerve Deafness from Drugs*—Taylor<sup>42</sup> reviews the drugs which may cause nerve deafness. Quinine is the most frequent cause of deafness, individual idiosyncrasy to the drug being the most important factor. Salicylates are second in importance. Alcohol, tobacco, arsenic, lead, phosphorus, carbon monoxide, carbon disulfide, mercury, morphine and the aniline dyes are all listed as occasional causes of deafness. Oil of chenopodium causes deafness in a considerable proportion of the cases in which it is used. The author emphasizes that these chemicals, especially quinine, may cause deafness in the fetus when given to the mother during pregnancy. Quinine should not be prescribed for pregnant women when there is a family history of deafness (suggesting a more vulnerable eighth nerve).

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<sup>42</sup> Taylor, H. M. Deafness from Drugs and Chemical Poisons, *Laryngoscope* 47: 692 (Sept.) 1937.

Taylor<sup>43</sup> brings home to the obstetrician the danger of using quinine during pregnancy or labor. He cites 5 cases of deafness in a child with no family history of deafness or syphilis whose mother had received quinine during pregnancy, at which time she had experienced tinnitus and deafness lasting a varying period.

Pellegrini and Nathan<sup>44</sup> review the experimental work on damage to the ear from quinine. In 1881 Kirshner showed extravasation of blood in the cochlea and semicircular canals resulting from experimental poisoning with quinine, but Gradenigo and Wittmaack showed that these hemorrhages were postmortem artefacts. Wittmaack in 1916 showed alterations of the vestibular ganglion and especially of the spiral ganglion from acute, subacute and chronic quinine poisoning. He found changes also in the basal nuclei and the cerebellum. Seiferth (1935) found no histologic changes in the ear and suggested that cerebral intoxication or vasomotor changes might be present. Wittmaack's finding of changes in the spiral ganglion could be confirmed in only a few experimental rats.

The authors carried out experiments with acute quinine poisoning on rats, testing the vestibular apparatus and noting spontaneous nystagmus. They conclude that quinine acts first on the peripheral vestibular apparatus and later on the centers controlling spontaneous movements of the eye and head. They suggest that the symptoms of acute poisoning from quinine are largely peripheral but are partly due also to central changes.

Falbe-Hansen<sup>45</sup> carried out experiments on patients with salicylates and quinine. Of 41 patients given salicylates, 8 showed no aural symptoms, while 33 showed tinnitus and deafness demonstrable by testing. Spontaneous nystagmus occurred in 10 and vertigo was frequent. After a few days the hearing always returned to normal, with no residual deafness. Quinine caused deafness, tinnitus, a feeling of pressure, perspiration and tremor in each of 22 patients. Of these, 8 were dizzy and 7 had spontaneous nystagmus. In several patients the symptoms were typical of Ménière's syndrome. The authors suggest that altered water content in the labyrinth probably accounts for the symptoms.

Covell and Noble<sup>46</sup> in a series of carefully controlled animal experiments determined the effect on the myelin sheath of the auditory nerve

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43 Taylor, H. M. Prenatal Medication and Its Relation to the Fetal Ear, *Surg., Gynec. & Obst.* **64** 542 (Feb.) 1937.

44 Pellegrini, E., and Nathan, R. Sul comportamento del sistema acustico-vestibolare nelle intossicazioni acute e croniche da chinino, *Ztschr. f. Hals-, Nasen- u. Ohrenh.* **41** 510 and 528, 1937.

45 Falbe-Hansen, I. Klinische und experimentelle Untersuchungen über den Einfluss von Salicyl und Chinin auf das Gehörorgan, *Monatschr. f. Ohrenh.* **71** 1055 (Sept.) 1937.

46 Covell, W. P., and Noble, L. The Significance of Myelin Sheath Degeneration for the Cochlear Nerve, *Ann. Otol., Rhin. & Laryng.* **46** 895 (Dec.) 1937.

of quinine, salicylates, staphylococcus toxin and deficiencies in various vitamins. In every instance they observed varying degrees of degeneration of the myelin sheath as compared with controls. The authors conclude that the myelin sheath of the auditory nerve is relatively unstable and its degeneration may be produced by a variety of factors. The changes are more pronounced in the basal whorl of the cochlea, and are more marked peripherally than centrally. The authors point out, however, that since cases of clinical deficiency in vitamins in human beings, such as beri-beri, scurvy, pellagra and rickets, are not accompanied by nerve deafness it is unlikely that lesser degrees of deficiency in vitamins are the cause of nerve deafness. The authors do not believe that degeneration of the myelin sheath of the auditory nerve is an adequate criterion for judging the production of nerve deafness.

*Nerve Deafness from Infections*—Ciocco<sup>47</sup> compared the audiograms of a large number of syphilitics with those of nonsyphilitic patients of the same age and found the incidence of nerve deafness not greater among those with syphilis and bone conduction not decreased in the syphilitic as compared with the nonsyphilitic patients.

Among syphilitic patients, nerve deafness was twice as common in those with neurosyphilis as in those without neurosyphilis. Defective hearing was as frequent among those who had received adequate treatment for syphilis as among the poorly treated or the untreated. The author concludes that treatment is neither beneficial nor deleterious to the hearing of the majority of syphilitic patients with nerve deafness. An exception occurs when deafness is associated with early meningeal neurosyphilis, when treatment results in a marked improvement in hearing.

Andersen<sup>48</sup> adds a fifth case to the 4 published cases of congenital syphilis of the labyrinth studied histologically. In a young man of 25 bilateral interstitial keratitis developed, with a positive Wassermann reaction. Energetic antisymphilitic treatment was carried out. At the age of 30 the patient awoke one night with marked vertigo, nausea and vomiting and complete deafness in both ears. The hearing improved somewhat in the subsequent days, but the vertigo persisted, and fourteen days after onset he came to the aural clinic. The right drum membrane showed a large, dry perforation, and a history of intermittent discharge since childhood was given. This ear heard nothing. The left drum membrane was thickened, and the left ear heard the conversational

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47 Ciocco, A. Nerve Deafness from Syphilis, *Laryngoscope* **47** 572 (Aug) 1937.

48 Andersen, H. C. Ein Fall von kongenitalem syphilitischen Ohrenleiden mit klinischer und pathologischer Untersuchung, *Acta oto-laryng* **25** 37 (Jan-Feb) 1937.

voice at the ear, with shortened air and bone conduction. There was no nystagmus from rotation but a strong caloric response from each ear. During six weeks while the patient was in the hospital receiving neoarsphenamine, bismuth and arsenic trioxide the hearing in the left ear improved until a whisper could be perceived at 25 cm. A few months later the patient met an accidental death.

Histologic examination showed old nonspecific healed otitis media on both sides, with thickened drum membranes. The labyrinthine capsule on both sides showed extensive gummatous osteomyelitis and periostitis with erosion into the lumen of the left vertical canal. The semicircular canals on both sides showed an irregular endosteal proliferation of bone extending into the perilymphatic space. There were no bony changes in the cochlea or vestibule. The membranous labyrinth showed, in addition to marked postmortem changes, a tectorial membrane on the right side rolled up into a structureless mass which had broken off here and there from its natural attachment and was dislocated upward. This appearance corresponds to the hypertonic-hydropic degeneration described by Wittmaack as the result of a hematogenous, tympanic or meningeal toxic effect on the cochlea and produced experimentally by him by injecting guanidine or calcium into the middle ear. In this patient the toxic effect was probably from the inflammation of the labyrinthine capsule.

These changes in the labyrinthine capsule are similar to those reported in the previously observed cases, namely, gummatous osteomyelitis, productive periostitis and gummatous periostitis. These are the changes which occur in other bones in congenital syphilis.

Leichenger and Ableson<sup>49</sup> reported a case of meningococcemia without meningitis in which deafness occurred two days after the start of treatment with antimeningococcus serum given intravenously. A lumbar puncture at the appearance of deafness showed normal spinal fluid and the drum membranes were normal. The authors believe that the exotoxin of the meningococcus caused a nonsuppurative lesion of the inner ear.

Proetz<sup>51</sup> describes brief diplacusis occurring in his own left ear during mild acute suppurative otitis media. The hearing in the affected ear was depressed about 15 decibels throughout the whole tone range but beginning at 1024 and increasing in degree to the upper limit of hearing the pitch was raised from one fourth of a tone to four and one-half tones as compared with the normal ear. Twelve days after the onset the

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49 Leichenger H and Abelson S M. Deafness Associated with Meningococcemia, *Arch Otolaryng* 26:306 (Sept) 1937.

50 Footnote deleted on proof.

51 Proetz, A. Diplacusis Binauralis Dysharmonica. *Ann Otol Rhin & Laryng* 46:119 (March) 1937.

dipacusis began to improve, the highest tones being the last to return to normal, seventy-two hours later. The author explains this temporary dipacusis as due to alterations in the strength, length or mass of the vibrating membrane at the base of the cochlea as the result of a local inflammatory process.

*Nerve Deafness from Allergy*—Dean, Agar and Linton<sup>52</sup> find in the literature reports of Menière's syndrome due to allergy, by Duke (2 cases), Proetz (1 case), Yandell (1 case), Vaughn and Hawke (several cases), Urbach and Wilder (1 case), Malone (2 cases) and Rowe (1 case). The authors have observed 7 cases of aural symptoms due to allergy. In 3 cases the Menière symptom complex appeared, 1 patient being sensitive to certain foods, 1 having associated asthma (cause not determined) at the time of the attack of dizziness and 1 being allergic to milk, butter and cheese. One patient was unconscious during an attack of Ménière's disease due to allergy to Crisco (hydrogenated cottonseed oil). Two patients had nerve deafness with attacks of vertigo, the hearing improving between attacks. (One was allergic to pollen and 1 sensitive to peas.) One patient had migraine and deafness without vertigo, due to sensitivity to wheat.

The improvement in the hearing of some of these patients, shown by audiograms, when the allergic attack was relieved was remarkable. The authors do not make clear whether they ascribe the defect in hearing to changes in the middle or the inner ear, but they imply the latter, since the drum membranes were usually unchanged.

*Nerve Deafness from Miscellaneous Causes*—Fowler<sup>53</sup> found that of 99 patients with Paget's disease, deafness was a major symptom in 41, tinnitus in 10 and vertigo in 23. While a few showed loss of hearing by conduction, the typical deafness of Paget's disease is nerve deafness usually for high tones, but in some cases extending throughout the tonal scale. This nerve deafness is clearly mechanical, due to compression of the internal auditory meatus by the deformed bone or to invasion of the modiolus and labyrinthine capsule. Recent studies have shown that Paget's disease can be definitely differentiated from most other diseases of bone by the much higher determination of phosphatase in the former. Since radiotherapy will arrest the disease in the long bones long enough to control pain, the author suggests that it be used in early stages of nerve deafness from Paget's disease. One patient so treated had a marked decrease in tinnitus and an improvement in hearing, which, however, was gone three years later.

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52 Dean, L. W., Agar, J. S., and Linton, L. D. Allergic Diseases of the Ear, *Laryngoscope* **47** 707 (Oct.) 1937.

53 Fowler, E. P., Jr. Nerve Deafness from Non-Inflammatory Lesions, *Laryngoscope* **47** 586 (Aug.) 1937.

Because certain investigators have called otosclerosis localized osteitis deformans, the author obtained determinations of the phosphatase in the serum in a series of 14 otosclerotic patients, with only 1 above normal and this 1 just barely above the normal limit

The author suggests that the nerve deafness that occurs in otosclerosis besides the defect in conduction is often due simply to the loss of hearing for high tones which is commonly found in older people. In a few cases otosclerotic foci around the internal auditory meatus or in the modiolus may press on the nerve and cause nerve deafness. A careful study of the eighth nerve in cases of otosclerosis has failed to substantiate Gray's finding of trophic changes.

Seaver<sup>54</sup> suggests that a reflex contraction of the tensor tympani and the stapedius muscle as a result of irritation of the fifth nerve from malocclusion of the temporomandibular joint causes tinnitus, vertigo and inner ear deafness. [The article is based apparently on pure speculation, with no case reports to show that this actually occurs.]

Scheideler<sup>55</sup> notes that since 1920, when Monson and Wright first referred to a relation between disturbed hearing and function of the temporomandibular joint, there have been a number of articles on this subject, all noteworthy for their lack of otologic basis. In attempting to evaluate these theories the author concludes that such increased function of the muscles of occlusion as occurs after loss of teeth can produce hypertrophy of the internal pterygoid muscles, which might interfere with the action of the tensor veli palatini muscle and lead to tubal occlusion. However, up to now it has not been proved that this actually does cause deafness. The author rejects the possibility of nerve deafness being the result of disturbed function of the temporomandibular joint.

Crawford,<sup>56</sup> in a wide and extensive experience with patients suffering from malocclusion and overclosure, has yet to observe any case of partial deafness in which correction of the bite improved the hearing, though he has observed several cases of vertigo improved by opening the bite and a few cases of temporary diminution in hearing relieved at once by swallowing or by depressing the mandible.

*Treatment of Nerve Deafness*—Selfridge<sup>57</sup> obtained a dietary history deficient in one or more vitamins, particularly in vitamin B, in a series of cases of nerve deafness. In most of the patients a definite

54 Seaver, E. P., Jr. Temporomandibular Joint Malocclusion and the Inner Ear. A Neuromuscular Explanation, *Ann Otol, Rhin & Laryng* **46** 140 (March) 1937.

55 Scheideler, J. Untersuchungen über die Beziehungen einer gestörten Kiefergelenksfunktion auf die Gehörorgane. *Arch f. Ohren-, Nasen- u. Kehlkopfh* **144** 59 (Dec) 1937.

56 Crawford, W. M. Malocclusion and Its Relation to Ear and Temporomandibular Disorders, *Laryngoscope* **47** 532 (Aug) 1937.

57 Selfridge, G. Eighth Nerve High Tone Deafness from a Nutritional Standpoint, *Ann Otol, Rhin & Laryng* **46** 92 (March) 1937.



improvement in hearing followed the administration of vitamin B. The author believes that because Covell, whose article is abstracted in the section on "Nerve Deafness from Drugs," found degeneration of the myelin sheath of the eighth nerve associated with deficiency in vitamin B the principal cause of degeneration of the eighth nerve in man is probably lack of vitamin B in the diet. [However, the author's assumption seems entirely unwarranted, since Covell himself pointed out that in cases of clinical deficiency in vitamin B (i. e., beri-beri) nerve deafness is not one of the symptoms. Moreover, the diets reported seem no more deficient than the diet of the average person with normal hearing.]

Kasabach<sup>58</sup> noted improvement in hearing in 6 of 9 cases in which intensive irradiation for carcinoma of the nasopharynx or near the ear resulted in exposure of the ear to the rays. Of the 6 in which improvement occurred, 5 were cases of tumor of the nasopharynx. Although the author mentions that the improvement in these cases may have been due to relief of occlusion of the eustachian tube, he concludes that "1000 roentgen rays may have a therapeutic value on the auditory system in selected cases." [This entirely unwarranted conclusion has already led to considerable harm in the form of unnecessary and useless irradiation in numerous cases of deafness in the vague hope that the rays will improve the hearing!]

Steinberg<sup>59</sup> offers an explanation for poor results in the correction of nerve deafness with hearing aids. Whereas in conduction deafness there is diminished loudness for all intensities of sound, in nerve deafness the ear hears with normal loudness sounds that are thirty or more decibels above threshold. The result is that, while an electrical aid will amplify all sounds equally for patients with conduction deafness, in nerve deafness, when faint sounds are amplified up to threshold, louder sounds will be heard as uncomfortably loud noises. The hearing is not only distorted but actually painful. To avoid this, selective amplification which amplifies faint sounds more than loud sounds will be necessary to obtain satisfactory hearing in nerve deafness.

*Ménière's Syndrome*—Dandy<sup>60</sup> has observed an aberrant artery pressing on the eighth nerve in 8 of 170 operations for Ménière's syndrome. Previous observations having shown that in most cases trigeminal neuralgia is due to arterial contacts with the sensory root of the trigeminal ganglion, the author believes that the two diseases are

58 Kasabach, V. Y. The Effect of Roentgen Rays upon Hearing, *Laryngoscope* **47** 545 (Aug) 1937.

59 Steinberg, J. C. Hearing Aids for Nerve Deafness, *Laryngoscope* **47** 603 (Aug) 1937.

60 Dandy, W. E. Ménière's Disease, *J. A. M. A.* **108** 931 (March 20) 1937.

entirely comparable and that Ménière's disease is always due to lesions of the vestibular portion of the auditory nerve. [He does not state what these lesions are when there is no aberrant artery and he does not explain the fact that in most patients with Ménière's syndrome the attacks stop spontaneously after a few years and are relieved by Furstenberg's diet.]

Brown<sup>61</sup> reports on a series of 12 consecutive patients with Ménière's syndrome treated by Furstenberg's low sodium diet with ammonium chloride medication. In all 12 cases the severe vertigo with vomiting was relieved although a few mild attacks occurred in several of the patients.

Aubry and Ombrédanne<sup>62</sup> divide Ménière's disease into the true form due to neuritis of the eighth nerve and an abnormal form associated with chronic suppurative otitis media in which in spite of intervention on the ear vertigo and headache persist. In this form pontocerebellar arachnoiditis is combined with neuritis of the eighth nerve. Tumors of the cerebellopontile angle produce a similar picture.

For both forms the authors use intracranial section of the eighth nerve according to Dandy's technic. The results in 29 cases were as follows:

1. Of 14 cases of true neuritis the vertigo was relieved in 100 per cent by total section of the nerve in 8 and section of the vestibular portion alone in 6.

2. In 14 cases of arachnoiditis 11 patients were cured, 1 was still dizzy because of complicating cerebellar encephalitis and 2 died of a flare-up of old apparently healed meningitis.

3. There was 1 case of tumor of the cerebellopontile angle.

Of the 11 cases in which the vestibular nerve alone was cut the hearing was much improved in 2, unchanged in 8 and destroyed in 1.

Mill<sup>63</sup> suggests that Ménière's syndrome may be due to an intracellular edema in the labyrinth resulting from a disturbance in water metabolism since a salt-free diet has led to good results. In addition to giving the salt-free diet one must rule out occlusion of the eustachian tube, foci of infection, tumors of the cerebellopontile angle or other neurologic disturbance (tabes, multiple sclerosis, cerebellar tumor).

If in spite of conservative measures the attacks persist operation is indicated. The author exposes the horizontal semicircular canal

61. Brown, M. R. The Medical Treatment of Ménière's Syndrome. *J. A. M. A.* 108:1158 (April 3) 1937.

62. Aubry, M., and Ombrédanne, M. Die Behandlung des otogenen Schwindels durch intrakranielle Durchtrennung des Nervus octavus. *Zschr. f. Hals-, Nasen- u. Ohrenh.* 40:509 1937.

63. Mill, W. A. The Operative Treatment of Ménière's Syndrome. *St. Thomas Hosp. Rep.* 1:192 1936.

through a simple mastoidectomy and opens its lumen with a tiny chisel until a needle can be introduced. One cubic centimeter of absolute alcohol is then injected anteriorly. A simultaneous conjugate deviation of the eyes is observed, not always in the same direction. The wound is closed completely. Postoperatively there are more or less marked vertigo, vomiting and diplopia, lasting as long as one week, with nystagmus toward the good ear. Hearing on the side operated on is completely destroyed. Slight dizziness may last several months, and the tinnitus usually persists. All patients were satisfied with the end results, and none experienced a recurrence of the severe vertigo. Seven cases are described in which operation was performed by this technic.

Rutherford<sup>64</sup> makes a trephine opening behind the knee of the lateral sinus and uses a flat retractor or a "cranoscope" to bring the eighth nerve into view. The cranoscope is similar to a cystoscope. The author operated in 1 case of Ménière's syndrome by this method, relieving the vertigo.

Tillé<sup>65</sup> reports 3 cases of aural and labyrinthine symptoms, with glaucoma. The author suggests that there is a form of hypertension of the labyrinth analogous to glaucoma in the eye. [Except for the association of the two conditions in his cases, he offers no proof for this suggestion.]

Dorochenko<sup>66</sup> notes that the etiology of Ménière's disease is still uncertain. Its frequent association with marked abnormalities of the capillary cutaneous circulation has been noted, and presumably the same capillary changes occur in other tissues, including those of the labyrinth. Recently Speransky has shown that a procaine hydrochloride block of the lumbar part of the sympathetic trunk can diminish certain pathologic processes by a rearrangement of the interrelations of the nerves.

The author has used a procaine hydrochloride block of the lumbar part of the sympathetic trunk in 4 cases of Ménière's disease with uniformly good results although previous treatments had had no success. The technic was as follows. The skin at the angle formed by the twelfth rib and the long dorsal muscle is first infiltrated with 0.25 per cent procaine hydrochloride. A needle 10 to 12 cm long is then introduced, 0.25 per cent procaine hydrochloride being injected as the needle goes in. After penetrating the muscles and the posterior sheet of the

64 Rutherford, R. Auditory Nerve Section in Meniere's Disease, *Brit M J* **1** 660 (March 27) 1937.

65 Tillé, H. Le syndrome glaucome labyrinthique. Note sur quelques observations de vertiges, hypoacousie et bourdonnements associés au glaucome oculaire, *Rev d'oto-neuro-opt* **15** 577 (Nov) 1937.

66 Dorochenko, I. T. Contribution à l'étude des rapports de la maladie de Meniere avec l'état trophique des nerfs. Traitement de la maladie de Meniere par le block à la novocaïne, *Acta oto-laryng* **25** 262 (May-June) 1937.

renal fascia, the tip of the needle reaches the interfascial space, which is perceived by the cessation of muscular resistance, and the procaine hydrochloride flows in more easily. The solution reaches the renal and the suprarenal flexus as well as the renal capsule, infiltrating also the part of the sympathetic trunk which lies close by.

Immediately after the first block the attacks of vertigo cease. Normal hearing has returned a week after a second injection. Two cases are cited, in each of which attacks of vertigo occurred two or three times a day, with nausea, vomiting, ataxia, nystagmus and defective hearing in one ear. After the first injection of procaine hydrochloride the attacks ceased. A second injection was given a few days later to prevent further attacks, and in these 2 cases there has not been an attack in more than a year.

Wittmaack<sup>67</sup> found that in experimental labyrinthine disturbance with nystagmus toward the sound ear, when the temporal bones were fixed intravitaly or immediately after death, the cupola and macula were voluminously expanded. By applying methylamine to the membrane of the round window, nystagmus toward the diseased ear was produced, and histologically the cupola and macula were shrunken (on the good side as well as that of the diseased ear). When labyrinthine and meningeal pressure are increased the cupola is shrunken, while sudden loss of perilymph after the horizontal canal is opened causes it to swell. Caloric and rotatory stimulation cause similar changes in the volume of the cupola. The author concludes that a nystagmus toward the sound side is evidence of a swelling of the cupola due to increased endolymph pressure, while nystagmus toward the diseased side indicates a shrinkage of the cupola (with decreased endolymph pressure). The author does not believe that deflection of the cupola occurs on rotation or calorization.

#### DISCUSSION OF THE CONTRIBUTIONS TO KNOWLEDGE OF OTOSCLEROSIS AND NERVE DEAFNESS DURING 1937

When one reviews and sums up the literature on otosclerosis of 1937, one can say that there is nothing particularly new or significant to add to knowledge of the etiology and pathology of otosclerosis. On the other hand, the treatment of otosclerosis is a more rapidly changing and developing field. The medical treatment of otosclerosis continues to give negative results, and this statement apparently includes Gray's intratympanic medication. The surgical treatment of otosclerosis, by Wittmaack's method of arresting the disease and by Holmgren and Sourdille's method of improving the hearing, continues to give promising results in the hands of a few.

<sup>67</sup> Wittmaack, K. Ueber die morphologischen Grundlagen der sogenannten Ausfalls- und Reizerscheinungen des Vorhofbogengangapparates bei entzündlichen Labyrinthkrankungen, *Acta oto-laryng* 25:109 (March-April) 1937.

In the study of nerve deafness there were several important advances during 1937. The so-called neuroepithelial degeneration of Corti's organ may merely be a postmortem artefact. Senile deafness is due to degeneration of the spiral ganglion beginning in the basal coil. The diagnosis of hereditary deafness still depends on the family history. Two types of hereditary deafness are to be distinguished—the recessive type, usually with profound deafness, occurring sporadically in a family, and the dominant type, with more often a moderate defect in hearing, inherited as a dominant characteristic. Traumatic or occupational nerve deafness is characterized by a dip in the audiogram, most marked for 4096 vibrations. Nerve deafness, with or without Menière's syndrome, may be due to allergy.

Finally, Wittmaack, the most creative and original writer of the present day on otology, makes two new contributions. He predicts that future advances in the etiology of nerve deafness will center around the labyrinthine fluids. He explains nystagmus from vestibular stimulation as being due to changes in volume of the cupola instead of to deflection of the cupola by currents of endolymph.

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# Abstracts from Current Literature

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## Ear

INCREASED ACOUSTIC SENSITIVITY IN DOGS FOLLOWING ROENTGEN-RADIATION OF THE HYPOPHYSIS W. J BROGDEN and E CULLER, *Am J Physiol* **119** 13 (May) 1937

Increased acuity of hearing was produced in dogs by roentgen irradiation of the head This was shown to be due to the effect on the hypophysis of the lowering of the blood sugar A diabetic subject and a normal dog showed increased acuity when the blood sugar was lowered with insulin and reduced sensitivity when the blood sugar was raised

NOURSE, Cleveland [*Am J Dis Child*]

CEREBELLAR ABSCESS, WITH DIFFUSED SUPPURATIVE LABYRINTHITIS A S FERNANDO and G DE OCAMPO, *J Philippine Islands M A* **17** 13 (Jan) 1937

Fernando and de Ocampo report a case of otogenic cerebellar abscess with recovery The patient was admitted because of symptoms pointing to labyrinthine disturbance Hearing and caloric tests showed that the labyrinth was completely irresponsive, there were phenomena, however, which could not be explained by this condition alone The direction of the nystagmus, toward the side of the diseased ear, which was not to be expected in a case of destroyed labyrinth, the continuous headache and insomnia and the mode of falling made the authors suspect the presence of intracranial involvement in addition to the diffuse suppurative labyrinthitis This belief was strengthened by the presence of slight rigidity of the neck on the day before operation This prompted lumbar puncture, which showed serous meningitis The meningitis was of the irritative or protective variety Suspicions were narrowed to a localized intracranial suppurative process—more specially, an abscess of the temporal lobe or of the cerebellum Symptoms and signs of involvement of the left temporal lobe were lacking The presence of cerebellar abscess was then evident, and on the morning of the operation (Newman-Jansen endocranial technic) additional, though vague, localizing symptoms appeared in the form of weakness of the grip of the left hand and adiadosokinesia When labyrinthitis and cerebellar abscess occur together, symptoms are confusing The patient was kept in the hospital for almost four months Maximal drainage and minimal traumatism were assured by cautious insertion of a rubber drain The pus obtained from the abscess was sterile, probably owing to disintegration of the bacteria by an unfavorable tissue reaction The route of infection must have been through the labyrinth Lumbar puncture made three months after operation revealed normal spinal fluid, which showed that the patient had recovered completely from the meningitis

EDITOR'S ABSTRACT [*ARCH NEUROL & PSYCHIAT*]

DISCUSSION ON OTITIS MEDIA IN EARLY CHILDHOOD (UNDER FIVE YEARS) J LE MEE and others, *Proc Roy Soc Med* **30** 1293 (Aug) 1937

Otitis media in early childhood is discussed in detail by the following men Dr J M Le Mée, Mr T Ritchie Rodger, Dr J H Ebbs, Mr Stirk Adams, Dr C E Scott, Dr R B Lumsden, Dr Douglas Guthrie, Mr E Watson-Williams and Dr McNair Scott Anatomic points in the production of otic infection, various types of involvement of the ear and of the mastoid, analyses of cases, statistical

reports on the incidence of otitis media and sinusitis, the bacteriologic picture the association of the disease with gastrointestinal disturbances and with pneumonia, its complications, prophylaxis, detailed reports of cases and the operative indications and technic are taken up. Personal views on many of these matters are expressed by the discussers, and some differences of opinion are noted. The subject is reviewed in an interesting and instructive manner.

CAMPBELL, Philadelphia

**NYSTAGMUS PROVOKED IN THE COMATOSE STATE** I ALFANDARY, *Rev d'oto-neuro-opht* **15** 161 (March) 1937

Stimulation of the vestibular apparatus during states of coma has generally been thought to result only in abolition of the quick phase of nystagmus, the eyes being drawn in the direction of the slow component. Alfandary studied the vestibular reactions to caloric stimulation of 11 patients in coma, chiefly of apoplectic origin. The results were (1) loss of the quick component of nystagmus, (2) disturbance of equilibrium between the two phases, so that the rapid phase occurred only at the beginning or the end of the test or persisted with the eyes in the deviated position and (3) slow deviation of the homolateral eye. A possible explanation of these phenomena is that the rapid phase, being the more recent phylogenetically, disappears first, then follows disappearance of associated movements and, finally, of all movements. These three modalities of the response to caloric stimulation do not represent three phases in the evolution of the comatose state. The only constant sign that accompanies progression of the comatose state is elevation of the threshold of excitation. Clinical and experimental researches indicate that the centers for both the slow and the rapid phase of nystagmus are located in the cerebrum, but in different places.

DENNIS, San Diego, Calif [ARCH NEUROL & PSYCHIAT]

**HISTERICAL DEAFNESS** G BUZOIANU, *Rev d'oto-neuro-opht* **15** 175 (March) 1937

Hysterical deafness, especially the unilateral pure form, is rare. Two types are distinguished: pure hysterical deafness and hystero-traumatic deafness. The deafness may be total or partial and may involve one or both ears. It may be isolated or accompanied with paralysis of other cranial nerves, by hemianesthesia of the skin or mucous membranes or by other disturbances of function. The duration of the disease may be a few days or several years, and recovery may occur spontaneously, as the result of an unexpected suggestion. Cases of unilateral deafness offer great diagnostic difficulties, because the preservation of the cochlear reflexes usually observed in cases of bilateral deafness is of no value if hearing is retained in one ear. A valuable diagnostic sign is the absence of a "false Rinne reaction," which is always present in cases of unilateral deafness of organic origin. The case of a young woman with total unilateral hysterical deafness is reported in detail. The nature of the trouble was recognized by the absence of the false Rinne reaction; immediate recovery was obtained by use of suggestion. In the beginning of the illness none of the hearing tests gave any response; after recovery they were normal. A number of cases of hystero-traumatic deafness occurred during the World War, as a result of the explosion of projectiles. Patients with this type of deafness should be referred to a psychotherapist.

DENNIS, San Diego, Calif [ARCH NEUROL & PSYCHIAT]

**EVALUATION OF AUDIOGRAMS** E WIRTH, *Arch f Ohren-, Nasen- u Kehlkopfh* **142** 164, 1936

Wirth studied the form and the differential diagnostic significance of 235 audiograms. In summarizing his observations he states that a greater impairment of hearing capacity on one side readily leads to errors because of overhearing by

the better functioning ear. For this reason, the audiogram of the more impaired ear is reliable only when closure of the impaired ear produces a different curve. Some of the audiograms are roundish and uniform, others are jagged and irregular. The irregular audiograms with deep indentations occur chiefly in cases of congenital hardness of hearing (sporadic deaf mutism) and of injuries of the cochlea. The audiograms of different patients with hardness of hearing rarely correspond in all details. Nevertheless, the 235 examined audiograms could be classified in eleven groups. Comparison of the audiograms with diagnoses made on the basis of examinations with the speculum and with the tuning forks revealed that some forms of audiogram are, to a certain extent, characteristic for disorders such as otosclerosis or cerebral tumor. However, the same or similar curves are found occasionally in association with disorders of entirely different origin. The fact that severe disturbances in sound conduction frequently cannot be recognized from the audiogram is a disadvantage. Consequently Rinne's test is advisable in addition to the audiogram. Hardness of hearing due to central disturbances shows in the beginning a severe reduction in the sphere of the higher tones and later a more uniform contraction of the auditory field, with great differences in the two sides. Similar curves, often with nystagmus, were found in cases of concussion of the brain. In cases of progressive impairment of the inner ear, there is a slow, concentric reduction of the threshold of hearing. Hereditary hardness of hearing is often but not always characterized by identical audiograms on both sides. In siblings, identical audiograms on both sides may be cited as indicative of the hereditary nature of the defect. The author concludes that if the examiner has sufficient experience with an audiometer, the audiogram permits a fairly correct estimation of hearing capacity. However, he warns against an overestimation of the electroacoustic methods and a neglect of the other methods of examination.

## EDITOR'S ABSTRACT

DIAGNOSIS AND THERAPY OF SECRETORY CATARRH OF MIDDLE EAR, WITH ESPECIAL CONSIDERATION OF PUNCTURE OF TYMPANUM. G. CLAUS, Arch f. Ohren-, Nasen- u. Kehlkopfheilk. **142**:186, 1936

According to Claus, a tympanic exudate is easily recognizable if the tympanic membrane is normal and thus readily permeable by light rays. The upper level of the fluid in the tympanum appears as a dark concave line, which moves as the position of the head changes. This line is missing only in the relatively rare cases in which the entire tympanum is filled with exudate. The second characteristic sign of secretory catarrh is the yellowish color of the tympanum. Contraction of the membrane, which is frequent, the author considers less important in the diagnosis of a tympanic exudate. The recognition of such an exudate becomes considerably more difficult if there are pathologic changes on the tympanic membrane. In cases in which the tympanic membrane is thickened a normally invisible level of exudate often becomes visible after air has been introduced into the middle ear. In cases in which pathologic changes in the tympanic membrane makes the recognition of an exudate impossible, thorough anamnesis is important. On moving the head forward and backward, patients with this condition often have a feeling of fluid in the ear. Intelligent persons often state this spontaneously and occasionally report that with the head in a certain position the hearing capacity improves. Some complain of a feeling of pressure or of fulness in the ear. These symptoms indicate a tympanic exudate, especially if the patient has had a cold previous to the appearance of the aural symptoms. The author shows further that, since many patients reject paracentesis if they are free from pain, puncture of the tympanum is helpful not only diagnostically but therapeutically. He performs this puncture with a syringe with 1 cc. capacity and a cannula 62 mm. long and 0.6 mm. in diameter. The puncture is made, if possible, in the anterior lower quadrant, otherwise in the posterior lower quadrant. In five years the



author resorted to puncture of the tympanum in 60 cases of tympanic exudate. The quantities of exudate varied between 5 and 44 cubic millimeters, in most cases between 20 and 30 cubic millimeters. The puncture was followed by inflation of the middle ear with air. In some cases puncture had to be repeated. Complete cure was effected in 53 cases, in the remaining 7, considerable improvement was obtained. The author does not resort to puncture at once but first performs the necessary therapeutic measures on the nose and the pharynx, applies heat to the ear and catheterizes the tubes or resorts to politizerization. If these measures do not produce the desired result, puncture of the tympanum is resorted to.

EDITOR'S ABSTRACT

PATHOLOGIC AND CLINICAL ASPECTS OF ACUTE MASTOIDITIS F. ALTMANN,  
*Monatschr f Ohrenh* 70 1465 (Dec) 1936

It is Altmann's opinion that among the numerous factors which influence the course of acute otitis or of the resulting mastoiditis, two are of especial significance, namely, the type of the pathogenic micro-organism and the anatomic structure of the mastoid. To be sure, such factors as the age and the sex of the patient may likewise be of influence. The author studied these various factors in 1,457 cases, in 98 of which both ears were operated on. An analysis of the cases according to the pathogenic organisms disclosed hemolytic streptococci in 66.2 per cent, *Bacillus mucosus* in 18.7 per cent, pneumococci in 10.9 per cent and various other organisms in 4.2 per cent. The paper is accompanied with tables which record the incidence of the different micro-organisms in the two sexes and in the different age groups. These tables indicate that hemolytic streptococci are relatively more frequent in nurslings and particularly in children and young persons than they are in older persons, whereas pneumococci are comparatively rare in young persons but become more frequent later. In discussing the incidence of the various micro-organisms in the two sexes, the author says that pneumococci show a slight predominance in male subjects. Further, he shows that the pneumatization of the mastoid process exerts an influence on the development and the course of mastoiditis. He differentiates four types of pneumatization, one normal and three inhibited types. In the more than half of the cases the mastoid processes showed good pneumatization, but since the course of acute otitis, and with it the tendency toward the development of mastoiditis, is greatly dependent on the anatomic structure of the mastoid process, the incidence of the various types of pneumatization in patients with mastoiditis permitted no conclusion regarding the frequency of the various types in normal persons. The author analyzes the material in regard to the number of days elapsing between the onset of the otitis and the surgical attention, to the relation between this time factor and the age and the sex of the patient, as well as to that between time and the type of infecting organism. The incidence of complications is analyzed with regard to these different factors. The author stresses the high mortality and particularly the high incidence of meningitis in pneumococcic infections.

EDITOR'S ABSTRACT

CLINICAL ASPECTS OF EXTERNAL PERFORATION IN ACUTE OTITIS MEDIA K. LOWY,  
*Monatschr f Ohrenh* 70 1493 (Dec) 1936

Lowy points out that suppurations within the mastoid process may, in the absence of spontaneous cure or of surgical evacuation, perforate at various sites. If perforation takes place toward the internal cortex, an extradural or an intracranial complication is the result. If the perforation takes place through the external cortex, however, a periosteal abscess and later a gravitation abscess may result. The author analyzes the perforations in cases of acute otitis or mastoiditis observed at the Vienna clinic between 1927 and 1933. In all cases (2,089 in all), antrotomy was done. The number of cases of periosteal abscess in which the site

of perforation was detected was 475, and there were 101 cases of periosteal abscess in which the site of perforation could not be found. A complicated gravitation abscess was observed only once, a rarity probably due to the fact that generally surgical intervention is made before this complication can develop. The author mentions the various sites at which perforation may take place and then indicates in tables the distribution of the various perforations according to age. He discusses the relation of perforation to pneumatization, to type of pathogenic microorganism and to intracranial complications and the duration of otitis previous to perforation. Intracranial complications are relatively rare in cases of periosteal abscess. The relatively frequent perforation of the internal cortex in cases in which external perforation has already taken place seems to corroborate the opinion of Krausz that there is no relation between perforation and the relief of pressure.

EDITOR'S ABSTRACT

RELATION OF PNEUMATIZATION TO COURSE OF ACUTE OTITIS MEDIA H. BARTH,  
Ztschr f Hals-, Nasen- u Ohrenh **41** 137, 1936

This report by Barth is based on 717 cases of acute otitis media which were observed in his clinic in four years. Surgical treatment was resorted to in 510 of the cases, and conservative treatment was employed in the others. There were 20 (2.78 per cent) fatalities from otogenic complications. The author discusses the value of the roentgenogram, pointing out that it gives a good survey over the pneumatization. To be sure, in cases of acute otitis media it is often difficult to estimate the cellular structure (regular or irregular arrangement of cells). The author adopts Schwarz's classification of five different types of pneumatization. Acute otitis media may occur in association with all types, but it is most frequent when there is a good development of the cells. In cases of considerable inhibition of the pneumatization, acute otitis media often heals spontaneously, and surgical treatment is less often needed than when pneumatization is good. The duration of the process is usually greater in cases of spontaneous cure and inhibited pneumatization than in cases of good pneumatization. In patients with unilateral otitis media in whom the pneumatization was different on the two sides, the ear with the poorer pneumatization was somewhat more often diseased than the ear with the better developed cells. Among 13 patients with bilateral otitis media but varying pneumatization, there were 10 in whom the course was the same on both sides, in 3 cases antrotomy had to be done on the better pneumatized ear, whereas the other ear healed spontaneously. Subperiosteal abscesses were observed in all types of pneumatization, but not in ears without pneumatization. Contrary to expectations, subperiosteal abscesses were somewhat more frequent in children between the ages of 5 and 9 years than in those between 2 and 4 years. In the higher age groups subperiosteal abscess becomes somewhat less frequent. The better the pneumatization, the more frequent is the subperiosteal abscess. No relation between the sinus involvement and the degree of pneumatization could be detected except that when there was no pneumatization the sinus was relatively often involved. However, on account of the small number of cases, no general conclusions can be drawn. Complications like labyrinthitis, extradural abscess and nonlabyrinthogenic meningitis were observed chiefly in patients with good or normal pneumatization. In a surprisingly large number of cases influenzal otitis or infection with pneumococci or with *Bacillus mucosus* affected patients with normal pneumatization. Moreover, in the cases in which there was a fatal outcome, normal pneumatization predominated. However, although there are indications of relations between the anatomic structure of the mastoid process and the course of acute otitis media, there are so many deviations from this rule that in the individual case the prognosis cannot be based on the pneumatization.

EDITOR'S ABSTRACT

DIRECTION OF NYSTAGMUS IN PRESENCE OF SYMPTOMS OF LABYRINTHINE FISTULA  
T HASEGAWA and M OKAWACHI, *Ztschr f Hals-, Nasen- u Ohrenh* **41**  
168, 1936

Hasegawa and Okawachi tried to find answers to the following questions  
1 Does the surgical production of a fistula on the semicircular canals produce two types of nystagmus in opposite directions? 2 Can the difference in the two types of nystagmus be explained by corresponding anatomic differences? 3 How can these manifestations be explained? The authors made their experiments on chickens weighing about 2 Kg. It was found that if the fistula was produced in the lateral semicircular canal the nystagmus was horizontal, whereas if the fistula was in one of the vertical semicircular canals the nystagmus was oblique and slightly rotatory (between anteroinferior and posterosuperior). When the rapid phase was directed backward, that is, from anteroinferior to posterosuperior, this was designated as a nystagmus toward the treated side. However, when the rapid phase was from posterosuperior to anteroinferior, the nystagmus was designated as being of the opposite direction. A tabular report indicates that in 5 cases nystagmus was toward the treated side and in 9 cases toward the opposite side. The first question is thus answered in the affirmative. The answer to the second question was furnished by microscopic studies. In the cases of nystagmus toward the opposite side the fistula always was at the site where the wall of the membranous semicircular canal is normally attached to the bone. In cases of nystagmus toward the treated side the fistula was on the wall of the perilymphatic space. These observations seem to indicate that direct pressure on the endolymphatic space produces nystagmus toward the opposite side and indirect pressure on the endolymphatic space produces nystagmus toward the treated side. The reply to the third question is not so simple, for although differences were observed in the size of the cupula and of the subcupular space in the two types of nystagmus, these differences do not provide an adequate explanation.

EDITOR'S ABSTRACT

### Pharynx

RECURRENCE IN MIXED TUMORS OF THE SOFT PALATE JONATHAN E RHOADS  
and PAUL M MCCRAY, *Am J M Sc* **193** 389 (March) 1937

Although mixed tumors of the soft palate resemble those of the parotid gland, recurrence after excision is rare. The authors report an instance of recurrence of such a tumor at the original site eleven years after its removal. Only 2 similar recurrences have been described among 60 cases of mixed tumor of the soft palate recorded in the literature.

LYNCH, St Paul [ARCH DERMAT & SYPH]

BASAL-CELLED CARCINOMA OF THE PALATE W A MILL, *Proc Roy Soc Med*  
**30** 922 (May) 1937

A case of adenocystic basal cell carcinoma of the hard palate is reported. The condition was treated first with radium, and later the tumor and hard palate were excised and the walls treated by diathermy. The result of the treatment is not mentioned.

CAMPBELL, Philadelphia

TREATMENT OF PERITONSILLAR ABSCESS BY TONSILLECTOMY ANTONIO E CARRASCO and FERNANDO J CASTELLANOS, *Rev med latino-am* **22** 179 (Nov) 1936

The authors advise immediate tonsillectomy in cases of peritonsillar abscess. They contend that the cause is eradicated before the condition becomes toxic and at a time when the patient does not object to the operation. In a series of 200 cases there have been no significant complications.

DWYER, Kansas City, Mo [AM J DIS CHILD]

PHLEGMON OF FLOOR OF MOUTH FOLLOWING FOLLICULAR TONSILLITIS H BRUNNER,  
Monatschr f Ohrenh **70**:1436 (Dec) 1936

Brunner describes the clinical history of a man aged 45 in whom after follicular tonsillitis a necrotizing suppurating phlegmon developed. It spread from the parapharyngeal space of the left side over the floor of the mouth in the form of a horseshoe. It was found that the phlegmon spread from one side to the other by way of the connective tissue space between the geniohyoid and the genioglossus muscle. From the clinical point of view, this case belongs with those in which the phlegmon takes an extremely rapid course.

EDITOR'S ABSTRACT

SIGNIFICANCE OF TONSILLECTOMY AND ADENOIDECTOMY IN DIPHTHERIA CARRIERS  
V HLAVÁČEK, Časop lék česk **74** 934 (Aug 30) 1935

Of 8 children ranging from 8 to 15 years of age who were designated as chronic diphtheria carriers (none had clinical diphtheria), 6 had frequent sore throats and 2 not even this symptom, 4 had congenital syphilis, 7 had enlarged tonsils and adenoids, and 1, merely enlarged adenoids. Cultures were obtained from 4 on the third day after uneventful tonsillectomy and adenoidectomy, the cultures from 3 of these were negative, on the ninth day the cultures from 7 were negative. In 1 case cultures made from the removed tonsils were negative. In another case the culture from one tonsil was negative. The cultures from the adenoids were negative in 4 of the 8 cases. Histologic studies were made of the removed tonsils and adenoids. Tonsillectomy removes cryptic foci in retrotonsillar folds, which are difficult to disinfect locally, and is recommended even for nonchronic carriers from the standpoint of reinfection of cryptic tonsils.

STULIK, Chicago [AM J DIS CHILD]

## Nose

PARANASAL SINUSITIS SIDNEY SAMUEL DUSHAN, Arch Pediat **54** 643 (Nov) 1937

Sinusitis may be classified as extrinsic, intrinsic or of physical or chemical origin. Either of the first two types may be acute or chronic. The extrinsic type is due to foods or excitants, the intrinsic, to bacterial infection. The last type is due either to heat and cold or to chemicals, and instances of it make up only a small proportion of cases of nasal disease.

ORR, Buffalo [AM J DIS CHILD]

UNILATERAL CHOANAL ATRESIA IN A WOMAN, AGED 23 T B JOBSON, Proc Roy Soc Med **30** 917 (May) 1937

Jobson reports a case in which one nostril was obstructed by a complete closure of the choanal opening by a bony wall. No treatment is suggested, but in the discussion similar cases are mentioned and methods of removing the obstruction discussed.

CAMPBELL, Philadelphia

DISCUSSION ON ORBITAL CELLULITIS DUE TO SINUS INFECTION, AND ITS TREATMENT E D D DAVIS and others, Proc Roy Soc Med **30** 1397 (Sept) 1937

E D D DAVIS discusses this subject from the symptomatologic, the diagnostic and the therapeutic standpoint. He mentions 54 cases of edema or swelling of the orbital tissues, in 72 per cent of which the condition was due to suppuration of the frontal or the ethmoidal sinus. He expresses the belief that if an orbital

abscess is present it should be drained promptly but that radical operation seldom is necessary. In many cases cellulitis in children subsides under conservative treatment.

S H Mygind bases his discussion on 86 cases of acute swelling of the orbit. He gives statistics covering various phases of his study of these cases, speaks of the frequent difficulty of diagnosis of orbital cellulitis of sinusal origin and its dangerous complications and emphasizes the need for thorough operative methods of treatment.

G H Howells emphasizes the operative care of patients with orbital cellulitis.

F C W Capps reports a series of cases, with details of the treatment in each case. He expresses the belief that suppuration is a definite indication for the external operation.

E Watson-Williams distinguishes between the type of orbital involvement in which there is infection between the bony wall of the orbit and the periosteum and the type in which actual infection of the orbital tissues occurs with cellulitis of these tissues and probably abscess formation.

W Stewart expresses the belief that cases in which streptococci are present operation should be barred in favor of medication with sulfanilamide or serum.

W S Thacker Neville advocates the administration of large doses of sulfanilamide.

CAMPBELL, Philadelphia

#### NASAL SUPPURATION IN INFANCY. BIOLOGIC TREATMENT. FRANCISCO BLOTTA, Rev. med. latino-am. **22** 1240 (Aug) 1937

Suppurative rhinitis and sinusitis from a variety of causes are described, with the various methods of treatment in common use. The author stresses the value of vaccines and, when the results of bacteriologic studies indicate it, of specific serums in cases of diphtheritic and streptococcal infection. Antistreptococcal serum is used locally in cases of nasal infection following scarlet fever. When vaccines are not effective, operative procedures are considered.

DWYER, Kansas City, Mo. [AM J DIS CHILD]

### Miscellaneous

#### USE OF PARA-AMINO-BENZENE-SULPHONAMIDE OR ITS DERIVATIVES IN TREATMENT OF BETA HAEMOLYTIC STREPTOCOCCAL MENINGITIS. FRANCIS F SCHWENTKER, FREEMAN P CLASON, WILLIAM A MORGAN, JANVIER W LINDSAY and PERRIN H LONG, Bull. Johns Hopkins Hosp. **60** 297 (April) 1937

Four cases of meningitis due to the beta hemolytic streptococcus are reported. Three of the 4 patients recovered. All were treated with sulfanilamide (para-aminobenzenesulfonamide) or its derivatives.

The authors believe that surgical procedures to eradicate septic foci are indicated in the treatment of streptococcal meningitis as an adjunct to specific therapy but that extensive surgical intervention should not be resorted to until the infection has been brought under control by the specific therapy.

LYTLE, New York. [AM J DIS CHILD]

#### LACK OF FITNESS AS THE PREDISPOSING FACTOR IN PNEUMONIA AND IN THE COMMON COLD. A LOCKE, J. Infect. Dis. **60** 106 (Jan-Feb) 1937

Infections of the type encountered in pneumonia and in the common cold may result from slowing up of the mechanisms normally continuously employed in the removal of invading bacteria from the circulating blood. The slowing up may be body wide. It is manifested in the rabbit in a lengthening of the time required for recovery of a normal temperature after chilling and in man in a lengthening of the time required for replacement of oxygen after exercise.

The speed with which the temperature can be recovered in the rabbit and the speed with which oxygen can be replaced in man under defined conditions have been used to establish a rating of fitness, or an index of ability to support rapid performance of work. Ninety-two per cent of 12 rabbits with a rating of more than six tenths of the possible maximum survived intravenous infection with small numbers of virulent type I pneumococci without intermediate fever and without apparent injury. One hundred per cent of 11 rabbits with a rating of less than five tenths of the possible maximum died within three days after such infection. Sixty-nine per cent of 16 rabbits with the higher ratings gave negative blood cultures for more than twenty-six hours after the establishment of an intradermal focus of pneumococcic invasion. Forty-four per cent were carried through to recovery. Not one of 16 rabbits with the lower ratings was able to check invasion following intradermal infection or to survive.

Sixty-four per cent of a mixed group of 28 persons with ratings above six tenths of the maximum reported one cold or less between Oct 1, 1935, and May 1, 1936. Eighty per cent of an equivalent group of 15 persons with ratings below five tenths reported four colds or more for the same period.

Influences which tended to lower or improve the rating in the rabbit were followed by parallel decreases in ability to survive pneumococcic infection. Among the factors which impaired fitness were maintenance in overheated quarters, morphine poisoning, toxemia and starvation when accompanied with losses in weight in excess of 25 per cent per day. Among the factors which improved fitness were removal to markedly cooler quarters, subcutaneous injections of from 0.1 to 0.4 cc of anterior pituitary extract, intravenous injections of 1 cc of an extract of adrenal cortex, intravenous injections of 2 cc of a 20 per cent solution of an extract of liver and feedings of the same extract in consecutive daily doses of 20 cc.

FROM AUTHOR'S SUMMARY [ARCH PATH]

HAEMOLYTIC STREPTOCOCCAL MENINGITIS TREATED WITH PRONTOSIL RECOVERY  
C F LUCAS, Brit M J 1 557 (March 13) 1937

Acute meningitis developed in a boy aged 9 years who had a discharging ear. Beta hemolytic streptococci were grown in pure culture from the spinal fluid. Two tablets of a derivative of sulfanilamide known as prontosil (the hydrochloride of 4-sulfamido-2', 4'-diaminoazobenzene) were given by mouth three times a day, and 10 cc of the disodium salt of 4-sulfamidophenyl-2'-azo-7'-acetyl-amino-1'-hydroxy-naphthalene-3', 6'-disulfonic acid was injected intramuscularly each day. The patient's temperature became normal at the end of thirty-six hours. The drug was administered for eight days. Recovery was complete.

ECHOLS, Ann Arbor, Mich [ARCH NEUROL & PSYCHIAT]

OBSERVATIONS ON SKIN SENSITIVITY IN ASTHMATIC AND CONTROL SUBJECTS  
R S BRUCE PEARSON, Quart J Med 6 165 (April) 1937

A comparative study of the cutaneous sensitivity of asthmatic persons and of normal controls was made. As a result of overlapping in the intensity of the reactions in the two groups, the author concludes that the value of cutaneous tests as a clinical procedure must be diminished and that no special importance can be attached to the presence of cutaneous sensitivity in individual cases unless its significance can be established on other grounds. As one might expect, the percentage of positive reactions and the proportion of large reactions were considerably greater among the asthmatic subjects, but positive reactions occurred with considerable frequency among the controls.

The review suggests that it would be significant if clinical asthma should later develop in some of the reacting controls.

BRADFORD, Rochester, N Y [AM J DIS CHILD]

DISTURBANCES IN TASTE AND SMELL AS LOCALIZING SIGNS IN LESIONS OF THE TEMPORAL LOBE R BRUN, J belge de neurol et de psychiat **37** 262 (April) 1937

Brun reports 2 cases of tumor of the temporal lobe associated with olfactory and gustatory hallucinations. Anosmia and hyposmia are not found in connection with central or cortical lesions of the olfactory or gustatory centers and consequently are of no diagnostic significance in localization of lesions of the temporal lobe. Perversions and hallucinations of smell and taste occur early and are of definite significance in the diagnosis of lesions of the basal and medial portions of the temporal lobe (hippocampus, uncinate gyrus and amygdaloid nucleus).

WAGGONER, Ann Arbor, Mich [ARCH NEUROL & PSYCHIAT]

OSTEOCLASTIC TUMOR OF THE PETROUS BONE J A RAMADIER and A TOURNAY, Rev d'oto-neuro-opt **15** 29 (Jan) 1937

The case reported is interesting because of the rarity of the condition and the surgical steps which led to the correct diagnosis and the use of roentgen therapy. Osteoclastic tumor, wrongly classed among the sarcomas, is not truly malignant, since it shows no tendency to recur or to form metastases. No case in which there was localization in the petrous bone has previously been recorded. A woman aged 36 suffered from an illness which began in August 1933 with neuralgic pains in the right hemicranium, radiating to the neck and the shoulder. Vertigo, tinnitus and deafness in the right ear next appeared, followed by peripheral paralysis of the facial nerve on the right side and, later, vomiting. The pains ameliorated in the morning and were increasingly severe later in the day, the severity lessening during the night. Lumbar puncture caused almost complete disappearance of the neuralgia. Examination revealed complete cochleovestibular paralysis of the right ear and a normal-appearing tympanic membrane. The results of a neurologic examination were normal, except for the seventh and the eighth nerve. There were no signs of cerebellar disturbance. The Wassermann reaction of the blood and of the spinal fluid were negative. A diagnosis of tumor of the cerebello-pontile angle was made, and the region was exposed. No tumor or evidence of arachnoiditis was discovered, but an area of softening of the posterior wall of the petrous pyramid, near the internal auditory meatus, was observed. A second operation, two months later, disclosed a spot of softening in the anterior part of the attic, which was curetted, and a mass containing the superior semicircular canal was removed. Exploration of the anterior face of the petrous bone revealed normal dura and osseous cortex. A course of roentgen therapy resulted in apparent cure of the disease.

Two series of roentgenograms were made. The first, made before operation, showed destruction of the inner half or two thirds of the petrous bone, the second, made after the operations, revealed repair by excessive recalcification.

DENNIS, San Diego, Calif [ARCH NEUROL & PSYCHIAT]

VESTIBULAR DISTURBANCES OF CENTRAL ORIGIN. CROSSED AREFLEXIA AND TYPICAL VESTIBULAR DISHARMONY J A BARRE and J P KIRCHER, Rev d'oto-neuro-opt **15** 241 (April) 1937

Barre and Kircher suggest the term *hemivestibule laterale homonyme* to designate their syndrome of vestibular disharmony. A man aged 43 was wounded in the left occipital region during the World War. Headaches and disturbance in equilibrium soon appeared and increased in severity during the succeeding years. Examination revealed diplopia, disturbance of associated movements of the eyes and limitation of ocular movement and nystagmus to the left. There was deviation of the extended arms to the left. Caloric tests with water at 27 and at 44 C gave correct reactions, but the threshold varied. In the right ear reaction occurred with the use of 40 cc of cold water, with warm water the threshold was obtained only after the use of 200 cc. In the left ear the thresholds were

100 and 40 cc, respectively. The threshold with the galvanic current was at 12 milliamperes in the right ear and at 3 milliamperes in the left. A few signs of cerebellar disturbance were elicited, more marked on the left side. The patient's condition improved, and he returned home. He was admitted to the hospital three years later, complaining of severe headaches, change in disposition, vertigo, diplopia, intermittent vomiting and stiffness of the neck. Cerebellar tests gave slightly incorrect reactions on the left side. Spontaneous nystagmus and deviation of the left arm to the left were present. The threshold of reaction to cold water was obtained with 125 cc in the left ear and with 300 cc in the right ear. The headaches grew worse, and paresis of the palate, vomiting, bradycardia and slow respiration followed. The eyegrounds were normal. Exploration of the posterior fossa revealed three small encapsulated abscesses and a deeper, larger abscess with thin walls in the cerebellum. After recovery from operation the clinical vestibular signs were nystagmus, deviation of the left arm to the left and falling to the right in the Romberg test. In the caloric tests there was marked inequality of the threshold for the two ears. There were hyperreflexia of the vestibular fibers which cause nystagmus to the left and hyporeflexia of those which cause nystagmus to the right. This case demonstrates that it is possible to isolate two groups of vestibular symptoms, each with its own cause and evolution. The subjective symptoms of hypertension disappeared after the operation, and the signs of damage to the vestibular system persisted. The original injury caused, first, damage to the vestibular and cerebellar pathways in the brain, probably from small hemorrhages, and second, a group of late disturbances, attributable to a minimal, but persistent, infection, culminating in formation of abscesses.

DENNIS, San Diego, Calif [ARCH NEUROL & PSYCHIAT]

OSTEOPLASTIC AND OSTEOCLASTIC CARCINOMAS OF THE PETROUS BONE AND ITS MORPHOLOGIC RELATIONS TO OTOSCLEROTIC DEGENERATION OF THE BONE  
A. GREIFENSTEIN, Arch f Ohren-, Nasen- u Kehlkopfh **142** 231, 1936

Greifenstein thinks that the rarity of reports on metastatic carcinoma in the petrous bone justifies him in describing typical osteoplastic carcinoma and osteoclastic squamous cell epithelioma. The bony labyrinthine capsule probably always remains free from true metastatic involvement and for a surprisingly long time remains free from the secondary spreading of the carcinoma. The development of an osteoplastic carcinoma in the petrosa is followed by lively processes of rebuilding, some stages of which may have a histologic similarity to otosclerotic changes. If these circumscribed carcinomatous processes of transformation come into topographic relation to otosclerotic foci, an exact delimitation may become impossible under certain conditions, the more so since there is histologic correspondence regarding the medullary fibrosis, the formation of blue reticular bone and the rarity of osteoclastic giant cells. Otosclerotic blue coverings are subject to the carcinomatous processes of rebuilding in the same manner as are the bones of the labyrinthine capsule. In the surroundings of a secondary and metastatic squamous cell epithelioma of the petrous bone, active rebuilding of the bone takes place, presenting the histologic aspects of osteodystrophia fibrosa and corresponding completely to certain manifestations of otosclerosis. In both types of carcinoma, the formation of primitive reticulated bone, which is rich in cement, is demonstrable, it corresponds to the so-called blue bone in young foci of otosclerosis. The pictures of the so-called sievelike perforation usually prove to be the early stages of this special form of the new formation of bone.

EDITOR'S ABSTRACT

DANGERS OF PARAVERTEBRAL ANESTHESIA OF CERVICAL PLEXUS EXPERIMENTS ON CADAVERS P. FALK, Arch f Ohren-, Nasen- u Kehlkopfh **142** 254, 1936

Falk points out that threatening complications and even sudden deaths follow paravertebral anesthesia. Experiments on cadavers proved that besides the possibility of direct injection into the lumbar sac or even into the spinal medulla, the



anesthetic substance may reach the dural sac and the spinal medulla by way of the nerve sheath in case of endoneural injection into a branch of the cervical plexus or into the cervical ganglion. In a case of paravertebral anesthesia of the cervical plexus which the author observed death resulted from injection into a branch of the cervical plexus and passage of the anesthetic fluid through the nerve sheath into the lumbar sac and the posterior crescent of the spinal cord, where a traumatic hemorrhage resulted. The author thinks that paravertebral anesthesia, according to Kappis, to Braun and to Hartel, should be avoided on account of the danger involved. The method of Kulenkampff, although without danger, often fails to produce adequate anesthesia. The method of Soerensen was used by the author successfully in more than 100 cases, but then suddenly it caused a fatality. Nevertheless, he thinks the last method permissible, with the restriction that it is inadvisable to inject more fluid while the needle is withdrawn from the depot position, for this involves the danger of endoneural injection.

EDITOR'S ABSTRACT

VERTIGO IN DISEASES OF BRAIN STEM R LEIDLLR, *Monatschr f Ohrenh* **70**  
1315 (Nov) 1936

According to Leidler, lesions of the brain stem frequently involve the central vestibular system. It is known that these disorders are often combined with vertigo, but nothing definite is as yet known regarding the localizing function of vertigo. The author shows that the investigation of vertigo is not identical with that of the vestibular reflexes and their disturbances, in spite of the fact that they have to go together. Manifestations on the part of the sympathetic system are important in recognizing the symptoms of vertigo, but here again are unsolved problems. 1. When are the sympathetic disturbances that accompany vertigo caused by the connections of the vestibular system with the sympathetic center in the medulla oblongata and when by the connections with the higher sympathetic centers in the diencephalon? 2. How in various types of encephalitis does the disorder produce spontaneous vertigo on one side and remain refractory to vertigo-eliciting stimuli of the labyrinth on the other side? 3. What is the role of the thalamus in the pathogenesis of vertigo? In conclusion the author emphasizes that vertigo can be regarded as a symptom neither of irritation nor of inhibition, for it is always both and is the psychic correlative for the disturbances in the regular course of all those mechanisms which insure the unconscious function of the labyrinth.

EDITOR'S ABSTRACT

SPONDYLITIS CAUSED BY SAFETY PIN IN ESOPHAGUS H NAVIS, *Ztschr f Hals-, Nasen- u Ohrenh* **41** 159, 1936

After reviewing the literature on safety pins in the esophagus, Navis reports an unusual case that was observed at the clinic in Leyden, Netherlands. A boy aged 3 was referred to the otorhinolaryngologic clinic by the orthopedic clinic, to which his parents had brought him on account of an extremely curved back. The roentgenogram of the vertebral column revealed an open safety pin apparently in the esophagus, approximately at the bifurcation, at the level of the fifth and the sixth thoracic vertebra. These two vertebrae showed a spondylitic process and the question arose whether this process had a connection with the presence of the safety pin. Already at the age of 18 months the child had been examined at the orthopedic clinic, because sitting up was difficult. At that time the vertebrae showed no lesions, but the safety pin was in the same position. However, no attention was given to it, because it was probably assumed that the pin, like several buttons which appeared in the roentgenogram, was in the clothing. In order to determine whether the spondylitis was caused by the safety pin, a new roentgeno-

gram was made after contrast medium had been introduced into the esophagus. The pointed part of the needle was behind the esophagus. It is assumed that the spondylitis had been caused by the inflammation, which, in turn, had been elicited by the perforation of the safety pin. It is peculiar that, with the exception of the curved back, the parents never noticed anything unusual. The child had always been able to eat everything and had never complained of pain. When told of the presence of the pin, the parents recalled that recently the child had not eaten properly and had repeatedly cried "pinprick." The pin was removed by esophagoscopy.

EDITOR'S ABSTRACT

# Society Transactions

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## AMERICAN OTOLOGICAL SOCIETY

HARRIS P MOSHER, M D, *President, Presiding*

*Seventy-First Annual Meeting, Atlantic City, N J, May 5-6, 1938*

ABSTRACTED BY DR ALFRED LEWY, CHICAGO

### Thursday Morning Session, May 5

ADDRESS OF PRESIDENT THE RESULTS OF THE EXPERIMENTAL FEEDING AND  
INJECTING OF QUININE ON THE MIDDLE AND INTERNAL EAR OF THE GUINEA  
PIG DR HARRIS P MOSHER, Boston

Small hemorrhages are commonly found in the basal whorl in the scala tympani. Four or five control animals showed this condition. Hemorrhage in connection with the administration of a drug, can be laid to the drug only when the blood vessels of the cochlea are congested. When there is extensive hemorrhage in the cochlea, serial sections show that it often overlies a blood vessel. This explanation is more satisfactory than the commonly held belief that the blood reaches the cochlea from the cranial cavity and is an artefact.

The cochlear aqueduct is filled with a fine network of fibrous tissue and acts as a sieve. When there is much blood in the basal whorl of the cochlea, corpuscles in diminishing amounts are found toward the cranial end.

An experimental animal killed by two blows on the side of the head without fracturing the skull was found to have abundant hemorrhage in the cochlea. In order to check the theory that hemorrhages may be due to suffocation attending anesthesia induced by chloroform, a pig was slowly strangled to death after primary anesthesia with ether, it showed no hemorrhages in fifty serial sections of the cochlea.

My experiments on animals showed that quinine, sodium salicylate and mapharsen, fed to the mother or injected, caused hemorrhages in the cochlea of the fetus. Mapharsen produced the most extensive hemorrhages, but the cochlea of the mother of the pig showed no hemorrhages. Hemorrhages in the fetus were in the scala vestibuli, the vestibule and the semicircular canals and were extensive. In the animals which received quinine and sodium salicylate the hemorrhages were also in the scala tympani. The findings seem to indicate that quinine and mapharsen have a selective action on different parts of the inner ear. The favorite sites for hemorrhage into the mesenchymal tissue of the ear are surrounding the ossicles, in the tissue covering the cochlea at its base and in the tissue lining the cavity of the bulla.

Drugs sometimes pass from the mother to the fetus, as shown by similar findings in both. What happens in animals probably also happens in man.

### SYMPOSIUM WHAT TREATMENT FOR OTITIC MENINGITIS IS JUSTIFIABLE?

(a) A HISTORICAL REVIEW OF THE SURGERY OF OTITIC MENINGITIS DR THOMAS  
J HARRIS, New York

The historical review serves as a brief introduction to the symposium on otitic meningitis. It gives a summary of the surgical procedures that have been under-



made between organisms present and organisms absent. Cloudy fluid is the result of the reaction of the tissue. If the infection is extradural there are no organisms in the fluid. If the infection has broken through, organisms are present, usually accompanied by diffuse suppurative meningitis. An analogous situation is seen in cases of hypopyon. If the infection has not broken through the cornea, the purulent fluid in the anterior chamber is sterile.

The recognition that sterile cloudy fluid means extradural infection is a strong indication for surgical removal of the focus. In cases of this type, the results are satisfactory.

Chemically, pathologic fluid shows increase in lactic acid and globulin, and the sugar-reducing substance often disappears.

Cytologically, 3 to 5 cells per cubic millimeter are present, usually the lymphocytes are normal. Clear fluid with increased numbers of lymphocytes is usually syphilitic or tuberculous.

The serologic examination should include classification of pneumococci. A streptococcus may be tested against various antistreptococcus serums.

In making the bacteriologic examination one should remember that much confusion has resulted from failure to report the presence or absence of bacteria and whether they are found in the smear alone or in the culture. The meningococcus is gram-negative, all other cocci in spinal fluid are gram-positive. Gram-positive cocci when degenerating may become gram-negative. One to 2 cc. of centrifuged fluid should be planted to insure growth.

In cases of suppurative meningitis the white cell count is usually high, as is the percentage of polymorphonuclears.

*Types*—The types are acute, subacute and chronic.

The term acute designates the fulminating type, such as follows: dislocation of the stapes, direct injury to the meninges or sudden invasion before any protective wall is built up. Surgical intervention is probably of no avail. The chronic condition is only relatively so. Ambulatory patients, with only a slight fever and headache, may suddenly become violently ill after weeks. This condition is often due to the type III pneumococcus.

In most cases the condition is subacute and lasts a week or ten days. This is the type of case in which skill and judgment may lead to a successful result.

*Pathologic Picture and Pathways of Infection*—The primary reaction is a protective one. Extension is in the form of osteitis, periostitis or osteomyelitis, and the pathologic picture is that of thrombophlebitis. The condition may arise also by direct extension, by injury or by infection of the blood stream. The pathway is usually through the mastoid cells but may be through the lymphoid tissue of the nasopharynx or from the nasal accessory sinuses. There are small areas of medullary matter in the temporal and other bones at the base of the skull, and one must be careful in the diagnosis of the pathway of infection. Some believe that infection occurs only through the cells of pneumatic bone, others, that it may appear at distant points by thrombophlebitic extension and that, for instance, an otologic infection may result from a sphenoid infection by thrombophlebitic extension.

#### (c) OTITIC MENINGITIS FROM THE SURGICAL STANDPOINT DR ISIDORE FRIESNER, New York

The various forms of meningitis as differentiated by laboratory examinations, particularly in the presence of analogous clinical phenomena, are all due to an infectious process within the meninges, and all the differences are merely of degree and extent.

Any operation designed for the cure of meningitis which has as its sole purpose the drainage of the cerebrospinal fluid, no matter how this is accomplished, must of necessity fail of its objective. Extension of infection in the meninges does not take place solely by diffusion, but infection probably does spread along the vessels.

The point of view of many, that the condition should be classified as healed suppurative meningitis only in those cases in which organisms have been demonstrated in the spinal fluid, is at variance with the opinions of others, who regard the presence of few cells in the spinal fluid as abnormal and the increase to more than 5 cells per cubic millimeter as significant of an early stage of meningitis. This apparently extreme difference of opinion as to what constitutes meningitis is understandable. It is evident that some change in attitude must obtain in order that the therapy of meningitis and its indication be clarified.

Changes in the spinal fluid, whether they are only an increase in the cell content or the presence of viable bacteria, are to my mind expressions of the degree, severity and extent of the inflammation in the meninges. I feel that as soon as these changes in the spinal fluid are discovered the indication for eradication of the suppurative focus is established, and in the last analysis the surgical treatment of meningitis is the early and complete eradication of the focus from which the meningitis takes its origin.

#### DISCUSSION

DR WELLS P. EAGLETON, Newark, N. J. Removal of the focus of infection is fundamental. Although a successful remedial treatment is instituted, failure to remove the focus may ultimately result in death.

The factors favoring recovery are limitation of the focus of infection in the bone and the presence of protective meningitis.

When there are few or no bacteria in the spinal fluid, as mentioned by Dr Dwyer, the mortality should not exceed 5 per cent.

The usual types of meningitis are

1 Infection at the angle of the petrosal sinus. The lateral arm of the basal cistern is filled with infected fluid.

2 Infection of the saccus endolymphaticus from adjacent osteomyelitis or from retrograde thrombophlebitis from the jugular bulb. An unlocking operation exposing the saccus, if done before general leptomeningitis ensues, is usually successful.

3 Infection within the internal auditory meatus from the labyrinth. The labyrinth should be drained through the middle ear and the arachnoid prolongation surrounding the meatus (cisterna pontis lateralis?) incised.

4 An old suppuration in the labyrinth. The pyramid should be unlocked and the lateral sinus freed and retracted as far as the adhesion of the dura to the lip of the internal auditory meatus.

5 Infection from the petrous apex. This causes 50 per cent of all intracranial complications from the ear. The apex should be fully unlocked and exposed before the dura is opened.

6 Meningitis involving the jugular bulb, with infection of the fluid in the lateral cistern. Evacuation of the fluid and removal of the surrounding medullary bone are necessary, to get rid of the infected small veins. Subsequent infection is avoided by immediate closure of the dural opening with a graft of mucosa from the lip. Fascia lata is not actively proliferating and dies early.

7 Toxic and allergic types of nonsurgical meningitis and scarlatinal streptococcic and pneumococcic meningitis, with a concomitant suppurating ear. The latter is to be treated surgically, but the meningitis should be regarded from the point of view of the causative scarlet fever or pneumonia. The overflow of bacteria is attenuated, and the condition does not require drainage of the cerebrospinal fluid.

(d) TREATMENT WITH SULFANILAMIDE. DR EMANUEL APPELBAUM, New York

The object of this paper is to present mainly the experience of the Meningitis Division of the New York Health Department with sulfanilamide in the treatment of meningitis secondary to infections of the ears and sinuses.

Sulfanilamide and its various derivatives have been used too short a time to admit of definite conclusions in regard to the relative merit of the different compounds, the best routes of administration and the dosage. The preparations that have been used are sulfanilamide orally, prontosil (disodium-4-sulfamidophenyl-2'-azo-7'-acetylamino-1'-hydroxynaphthalene-3',6'-disulfonate, now known as neoprontosil) intramuscularly and at times an 0.8 per cent solution of sulfanilamide intraspinally, subcutaneously or intravenously. Recently my associates and I have used also prontosil in solution intraspinally and in powder form orally. As a rule, 5 cc or less of the prontosil solution has been given every four hours to younger children and 10 cc every four hours to older children and adults. In addition, from 5 to 15 grains (0.32 to 0.97 Gm) of sulfanilamide has been given every four to six hours. The same dosage was followed when prontosil was given by mouth. We do not feel sure at present that there is any advantage in administering sulfanilamide intraspinally.

While sulfanilamide is a therapeutic agent of great value it has also toxic qualities, the most serious of which is the production of hemolytic anemia and of granulocytopenia. We have not encountered any of the more serious reactions. We do not consider cyanosis an indication to stop the drug.

We have used sulfanilamide in the treatment of 5 miscellaneous infections of otitic or sinus origin, with 4 recoveries and 1 death.

A patient with meningitis due to *Bacillus influenzae* treated with this drug died. There were 3 cases of meningitis due to the nonhemolytic streptococcus, with 1 recovery.

We have used sulfanilamide in 32 cases of pneumococcal meningitis. In most of these, the condition was associated with otitis or infection of the sinuses or of the upper part of the respiratory tract, occasionally it followed pneumonia. In this series there were only 4 recoveries. While the clinical results from the treatment of pneumococcal meningitis with sulfanilamide are far from satisfactory, they are nevertheless encouraging.

The use of sulfanilamide in cases of hemolytic streptococcal meningitis has yielded astounding results. We have had 26 cases, with 21 recoveries and 5 deaths.

It is important in treating all forms of meningitis adequately to drain the subarachnoid space. The prompt and complete eradication of the primary foci of infection is of particular importance when meningitis is secondary to infection of an ear or a sinus.

#### DISCUSSION

DR JOSEPHINE B. NEAL, New York: I have always questioned the efficacy of sulfanilamide against infections in bony tissues, as I have often seen persistence of the infection in spite of adequate dosage and in spite of the fact that the course of the disease was evidently prolonged.

I recall 1 patient who did not recover entirely after a mastoidectomy until the other mastoid was operated on. This occurrence emphasizes the need of early diagnosis and removal of all foci of infection.

When block occurs in infants with open fontanels ventricular is preferred to cisternal puncture. It is safe and more likely to be effective. No fatalities have followed cisternal puncture in over 30 cases. It is more dangerous in the presence of adhesions and congestion of the blood vessels, as in cases of meningitis, than in cases of syphilis.

"Forced drainage" has been tried without any favorable effect. In some cases unfavorable effects appeared at necropsy. The results of sulfanilamide in the treatment of hemolytic streptococcal meningitis have been amazing. There were a few deaths, mostly due to attendant circumstances, but what medication gives 100 per cent recoveries?

I repeat Dr Applebaum's praise of sulfanilamide and point out that reliable products must be used.

In conclusion I should like to challenge the members of the society to find methods for earlier diagnosis of mastoiditis and sinusitis.

DR PHILIP E MELTZER, Boston Dis Dwyer, Friesner and Eagleton emphasized removing the focus Is it always possible to find it definitely in the absence of a pathway of necrotic bone or at least an inflammatory reaction of convincing degree?

In the cases in which one cannot tell, what procedure is advocated? How far is the decompression of the cerebral fossae carried? Are removal of the entire anterior surface and exposure of the carotid canal advocated? What is done about the posterior surface and the group of cells underlying it?

DR MOSES H LURIE, Boston Has the New York Health Department been doing blood tests for immunity on patients treated with sulfanilamide? Dr Lyons, at the Massachusetts General Hospital, has and finds that when systemic resistance is poor the sulfanilamide does not act so well After transfusion from an immune donor the sulfanilamide was found to increase from three hundred to five hundred times the patient's ability to absorb and destroy the infective organisms

DR BURT R SHURLY, Detroit Perhaps after an experience of forty years one is entitled to grow first enthusiastic and then displeased It is of greatest value to recognize one of the splendid discoveries of the last few years Sulfanilamide, in my experience, is one of the greatest things known to therapeutists for the treatment of infections of the nose, throat and respiratory tract extending down to the lungs Of the last 100 patients with pneumonia treated in the hospital with which I am associated, 6 have died My colleagues and I used diathermy twice a day and the highest possible dosage of sulfanilamide The dangers of the use of this drug must be recognized by the profession Druggists are selling it over the counters as they sell acetylsalicylic acid There are toxic symptoms that can be determined only by daily examination of the blood We had 4 patients with mastoiditis and 1 with petrositis prepared for operation in accordance with the opinion of several surgeons They were placed under observation in the hospital for twenty-four hours, with oral and hypodermic administrations of sulfanilamide The improvement was so great that the treatment was continued, and the patients have recovered without surgical intervention It is only under observation in a hospital that one can afford to allow operation to be delayed, because the best surgical judgment followed by removal of the focus is necessary

The toxic symptoms, cyanosis and acidosis, can be relieved by the use of 30 Gm of bicarbonate of soda with the sulfanilamide Patients with toxic conditions which result in acute hemolytic anemia or optic neuritis in the presence of renal insufficiency and those that are in a bad general toxic condition should be watched with even greater care The table for dosage should definitely be given out to the members of the medical profession (e g, 160 pounds [72.6 Kg], first dose 120 grains [7.76 Gm]), but dosage should be determined by the study of the individual case We feel this medication should be continued through the night We gave the dosage six times during twenty-four hours One cannot expect the same results in cases in which *Streptococcus haemolyticus* is not the infecting organism, although we have had improvement of great value in cases of pneumococcal infection

DR BERNARD J MCMAHON, St Louis My associates and I have conducted experiments on rabbits with the idea of determining the amount of sulfanilamide deposited in the tissues of the nose and sinuses Dr Arellano has mentioned that sulfanilamide is not deposited in bone The nasal walls are not solid bone, but a thin type of bone, transversed by many openings and filled with areolar tissue and with capillaries which have a relatively large amount of mucosal covering

Dr Neal mentioned that she had seen no good results from treatment of nasal infections with sulfanilamide I believe these are mixed infections We found in the blood of our rabbits sulfanilamide, from 17 to 75 mg per hundred cubic centimeters, and in the nasal tissues from 17 to 47 mg per hundred grams Marshall, Emerson and Cutting found 19 mg per hundred grams in the liver, as a maximum, and 3 mg in fat, as a minimum, when the hemolytic streptococcus was



established in the sinuses of rabbits. Sulfanilamide was then given four consecutive days in maximum doses, and the rabbit was killed. We did not attempt to cure the sinus infection entirely, because we were interested in determining the effect of sulfanilamide when infection was present in the tissues. No considerable pathologic changes resulted from the administration of sulfanilamide, with or without infection. Those which were present were due to the infection. The administration of the sulfanilamide did not influence the number of polymorphonuclears or monocytes or the amount of phagocytosis. The toxic signs are important. One of the toxic signs in our rabbits was hyperpnea, coming on as early as eighteen hours after as small a dose as 1.5 Gm per kilogram. In other rabbits, with five times this dose, there were no toxic signs. However, in the majority of our rabbits toxic signs did develop. Hyperpnea usually occurred first, then apathy and later spastic and flaccid paralysis, especially of the hindlegs. The toxic signs usually abated in the reverse order of their onset.

We feel confident that sulfanilamide is deposited in the nasal and sinus tissues, and if the infective agent is a pure streptococcus one can be reasonably assured that it will be effective, as it is against streptococcal infection elsewhere. We believe this applies also to the mastoid, although we made no actual examinations of tissue of infected mastoids.

DR JAMES G DWYER, New York. I emphasized in the beginning that if one could find the focus common sense must guide in one's procedure. In many cases, by study one can get an indication of the source of infection. At postmortem examination masses of thrombosed vessels from the bone into the dura have been found. In such cases, if one removes the bone and removes the infection one will accomplish a great deal. As Dr Shurly pointed out, several patients that were prepared for operation got well without it.

In the report to be made tomorrow is a description of 3 cases of meningitis with complications in the mastoid in which patients refusing operation recovered. That is not advocated. The value of removing the focus can be overstressed. If there is one and it is accessible, it should be removed.

DR EMANUEL APPELBAUM, New York. The question of eradication of the primary foci is a surgical one, which I am not qualified to answer. It is to be noted that 8 of 26 patients recovered without operation. Perhaps a more effective agent will be found which will make it unnecessary to operate on the primary foci.

My associates and I have made no studies of immune properties in the patients' serum during recovery. Antiscarlatinal serum or serum from patients convalescent from scarlet fever has not been successful against streptococcal meningitis. Recent work by Branham and Rosenthal indicates that a combination of specific serum and sulfanilamide yields better results than either agent alone in the treatment of meningococcal and pneumococcal infections in mice. It is our clinical impression that this is true of meningococcal meningitis.

#### SURGICAL TECHNIC FOR CONSERVATION OF THE HEARING IN CASES OF CHRONIC MASTOIDITIS. DR J M SMITH, New York

The operations for chronic mastoiditis are classified, according to the anatomic and pathologic conditions present, into four classes: (1) the complete simple operation, (2) the complete simple operation plus the removal of the incus, (3) the new radical operation and (4) the complete radical operation.

The complete simple operation is the usual antrotomy, with wide exposure of the antrum and dissection of the root of the zygoma until the short process of the incus is thoroughly exposed. All accessible granulation tissue in the posterior part of the aditus is removed. Hydrogen peroxide and saline solution are used to flush the cavity during operation. A cigaret drain is inserted into the antrum, and plastic repair is not done on the canal. This operation is chiefly indicated for the treatment of young children and the conservation of hearing.

The complete simple operation plus removal of the incus is performed like the one just described. The incus is dislocated backward into the antrum by a eustachian curet and removed. The malleus is now visible but is not disturbed. All accessible granulations are carefully removed. The removal of the incus has little effect on the hearing. Postoperative care is like that for the foregoing operation. Plastic repair is not done.

The new radical operation is the same as the two just described, but a small part of the bridge next to the incus is removed from within outward to enlarge the aditus. The eustachian curet is used to dislodge the malleus and is removed with a small forceps. This enlarges the space connecting the mastoid cavity and the external auditory canal and permits through and through irrigation. The membranous canal is not disturbed. Through a speculum in the external canal, granulations may be curetted from the promontory downward, backward and forward, with avoidance of the facial nerve and stapes. Remnants of the drum membrane may be removed. The annulus is allowed to remain. The eustachian tube is curetted. After irrigation, alcohol is freely used. A folded rubber tissue is inserted into the opening between the middle ear and the mastoid antrum. A cigaret drain is inserted into the canal and middle ear and another into the antrum. Daily through and through irrigations are essential. The objective is a dry, clean middle ear with a healed mastoid wound.

The complete radical operation is chiefly indicated after failure of one of the procedures just described or when the internal ear is involved or there is intracranial extension, paralysis of the facial nerve, petrositis or extensive cholesteatoma.

A series of case reports illustrates the opinions expressed.

The technic described not only conserves but improves the hearing in many instances.

#### DISCUSSION

DR H I LILLIE, Rochester, Minn. Cases of chronic suppurative otitis media in which a cure has been effected by natural reparative processes have been generally observed. All the surgeon can do is to help these processes accomplish their aim by removing the obstacles. The recognition of these obstacles is surgical judgment.

For the choice of the technical procedure for combating a given pathologic process, the history often may give more important information than the examination. I feel that when the presence of cholesteatoma is strongly suspected, some form of radical operation must be used. I am in close agreement with Dr. Smith about operative measures through the external auditory canal. Pathologic processes in which the posterior and the superior bony wall of the external auditory canal have been destroyed by the disease, only the membranous canal being left, have been observed. The intra-aural removal of the overlying membranous meatus and postoperative treatment were sufficient to effect a cure. If the bony wall has not been destroyed no intra-aural surgical measure will be adequate.

If the pathologic lesion is such that life is threatened, the conservation of hearing is secondary. A prosthesis can be used.

Patients are disappointed with results of operation on the mastoid if the discharge persists. If the disease is situated in the attic and mastoid antrum and if the drum and ossicles are present and the defect is too small to permit direct treatment, the modified radical operation is to be preferred. It helps conserve the hearing, does not expose normal membranes on the promontory and in the eustachian orifice and thus prevents a discharging ear. Unless the promontory is covered by scar tissue, the ear is always moist.

DR JOHN R PAGE, New York. It is good to hear Dr. Smith emphasize the obligation to develop different methods for different conditions of chronic mastoiditis and to preserve and improve hearing whenever it is possible to do so with safety to the patient. In 1925 an article on this subject was published from the clinic with which I am associated. It recommended preliminary removal of tonsils

and adenoids It agreed with Dr Smith that the type of operation should depend on the conditions found and on the degree of hearing present and that one ought not to follow the more radical procedure unless led to do so by a condition found in the mastoid It recommended careful consideration of the hearing and of the condition of the ossicles before the removal of any of them, particularly when the hearing is good, as it is usually the disease around them rather than the disease of the ossicles themselves that is a menace

Even with great destruction of the drum membrane, if safe for the patient the conservative mastoid operation or some modification of it to suit the individual case and time for ventilation and treatment through a wide meatus are recommended

Opposition to lowering the posterior wall of the canal and constructing a new meatus is not quite clear A large cavity in the mastoid can be avoided by removing the tip and the ridge over the digastric muscle In many cases the cortex can be beveled back so that the soft parts fall in close to the inner plate It seems that when the membranous and bony canal are left intact, narrower access to the part to be treated and poorer ventilation will be obtained It seems that with removal of the incus alone the drum membrane acts more as an obstruction or baffle than as an aid to hearing and that it might better be removed like a false membrane that sometimes forms across the tympanic part of the cavity left by a radical mastoidectomy

There has been a growing tendency at the clinic to attempt preservation of the drum and ossicles in cases in which the hearing is too poor and the tympanum too much involved to warrant it The radical mastoidectomy is more apt to improve the hearing in such cases than is the modified operation This tendency is probably due to the after-treatment, which is more painful and prolonged than that after the conservative operation

Dr Smith is to be congratulated on his good work In his hands results are obtained through a narrow canal that in other hands are better obtained through a wide one

DR J M SMITH, New York The decision to leave the wall of the canal is optional and must be made according to the operator's results If cutting a flap is avoided one avoids a cavity as well as much after-treatment

On account of the tendency of cholesteatoma to recur, I believe a complete radical operation is preferable if there is a normal ear on the other side

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### CORRECTION

In the article by Dr Samuel J Kopetzky entitled "Purulent Otitis Media, Sinus Thrombosis and Suppuration of the Petrous Pyramid Acute and Chronic Forms," which appeared in the October issue (*ARCH OTOLARYNG* 28 626, 1938), the term "middle cranial fossa" at the end of the tenth line from the top of page 647 should have read "posterior cranial fossa"

# Book Reviews

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**The Life of Chevalier Jackson. An Autobiography** By Chevalier Jackson, M D Price, \$3 50 Pp 229, with 80 illustrations New York The Macmillan Company, 1938

One has a certain trepidation in approaching an autobiography, but this will be completely dispelled in the perusal of such a sincere and fascinating medical romance as this recorded life of Chevalier Jackson, the motive of which is to present, not a chronicle of achievement, but, in his own words, "a sugar coated pill on preventive medicine" The record of hardships in the brutal contacts of his sensitive childhood, in the almost insurmountable difficulties in obtaining an education and in service ranging from that of a plumber's cub to the cook's galley on the codfish banks finds perhaps a certain parallel in the thrilling path to scientific heights chronicled for Madame Curie by her daughter

Early flashes which forecast the bronchoscope appear in this life history, such as the invention of the fishing tool to extract the sodden mass of cord in a broken-down oil drilling apparatus, the devising of a method for the extraction of the pushed-in cork of an olive bottle and the accumulation of experience with the varied types of valves essential to pipes, pumps and plumbing later to be applied to human bronchial tubes

His expression that bronchoscopic work, so close to the beating heart, realizes the ideal of being close to the very machinery of life is perhaps characteristic of the man

Coincident with the constant depression of his developmental period, bits of fine philosophy appear The fundamental biologic fact that death is an irreversible process was deeply impressed while he struggled for the life of a little injured rabbit and remained as a constant fear lest his patients cross this irremediable line, the dogged determination to suffer in silence the abuse of childhood, with the apologetic acceptance of the school bully's attitude as a defense mechanism, fits the pattern of his later irresistible spirit His patience in fighting repeated pulmonary crises, with an insatiable longing for health to complete his mission, accords with the generosity pervading his entire medical life

One is impressed with an essential orderliness in routine, even in early life, and in his later indefatigable devotion to his life's work the careful education, really self education, in all that would contribute to a completely artistic culmination seemed almost an obsession His positive views on the obligation of medical appointments and his specific principle in medical writing that there should be a clear separation of clinical facts from deductions and opinions are a logical sequence The careful preservation of all the important correspondence which appears in this volume is but another evidence

To these traits were added a cheerful omission of entangling social engagements, the preference for early morning literary work in solitude and total abstinence from alcohol and tobacco, for the sake of a clear head and a steady hand, as well as on moral principle This teacher has been an artist of rare ability, has idealized womanhood, has had the gentlest touch with children, has been generous to a fault with assistants and has bestowed little thought on money

This review should perhaps have been more critical, but one finds little to criticize, and I do not agree with one statement, that "it is not a doctor's book"—this stimulating narrative might be read with value before, during and after the medical education of every student

# Directory of Otolaryngologic Societies \*

## FOREIGN

### COLLEGIUM OTO-RHINO-LARYNGOLOGICUM AMICITIÆ SACRUM

President Dr Louis Ledoux, Brussels, Belgium  
Secretary Prof Dr C E Benjamins, Verlengde Heereweg 143, Groningen,  
Netherlands  
Place Brussels, Belgium Time September 1939

### HUNGARIAN OTOLARYNGOLOGICAL SOCIETY

President Dr J Treer, Bocskay-u 9, Szeged  
Secretary Dr G Kelemen, Realtanoda-u 9, Budapest

### SOCIEDAD RIOPLATENSE DE OTO-RHINO-LARINGOLOGIA (ARGENTINE SECTION)

President Dr Raul Becco, B Mitre 1690, Buenos Aires  
Secretary Dr Juan Manuel Tato, Santa Fe 1171, Buenos Aires

### SOCIÉTÉ FRANÇAISE D'OTO-RHINO-LARYNGOLOGIE

Secretary Dr Henri Flurin, 19 avenue Mac-Mahon, Paris (17°)  
Time Oct 24-26, 1938

## NATIONAL

### AMERICAN MEDICAL ASSOCIATION, SCIENTIFIC ASSEMBLY, SECTION ON LARYNGOLOGY, OTOLOGY AND RHINOLOGY

Chairman Dr H Marshall Taylor, 111 W Adams St, Jacksonville, Fla  
Secretary Dr Leroy A Schall, 270 Commonwealth Ave, Boston  
Place St Louis Time May 15-19, 1939

### AMERICAN ACADEMY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

President Dr George M Coates, 1721 Pine St, Philadelphia  
Executive Secretary Dr William P Wherry, 1500 Medical Arts Bldg, Omaha  
Place Chicago Time October 1939

### AMERICAN BRONCHOSCOPIC SOCIETY

President Dr John D Kernan Jr, 120 E 75th St, New York  
Secretary Dr Lyman Richards, 319 Longwood Ave, Boston

### AMERICAN LARYNGOLOGICAL ASSOCIATION

President Dr George B Wood, 504 Physicians' Bldg, Philadelphia  
Secretary Dr James A Babbitt, 1912 Spruce St, Philadelphia

### AMERICAN LARYNGOLOGICAL, RHINOLOGICAL AND OTOLOGICAL SOCIETY, INC

President Dr Harold I Lillie, Mayo Clinic, Rochester, Minn  
Secretary Dr C Stewart Nash, 708 Medical Arts Bldg, Rochester, N Y

## SECTIONS

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Place Boston Time Jan 11, 1939

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